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VOL. 13, No. 3 SEPTEMBER, 1947

The Advancement of Australian Primary Products*

By

J. A. BAKER, B.Agr.Sc.

I have entitled this paper " The Advancement of Australian Primary Products ". By that I mean the advancement of primary products by organized promotion. That, in turn, does not refer merely to the promotion of sales. As applied to primary products, the term " promotion " has a far wider meaning, for it includes all measures supporting the industry from the point of production to the final point of sales to the public. It essentially involves the agricultural research worker and the extension officer who, indeed, form the first link of this chain of operations.

How these individual operations are related can be easily demonstrated. For instance, it is obvious that research and extension to reduce costs of production are of direct assistance to sales promotion. It is also apparent that research which discovers new uses for a product provides the sales promotion section with most valuable material for its work. An example of this was the discovery of methods for making wool shrink-proof. But it is not generally appreciated that this process can also operate in reverse—that is, the sales promotion section can suggest original basic research projects for the scientist. For example, the importance of wool grease in preventing rust emerged during the war and the International Wool Secretariat believed that there might be opportunities of discovering many other new uses for this by-product of the scour. As a result of its suggestion, British scientists have embarked on a ten-year investigation of the chemistry of the sterols, of which comparatively little is known.

To the best of my knowledge no comparison has been yet made from the point of view of promotion, of the big four primary industries of wool, wheat, meat and dairy produce. Accepting the real meaning of promotion as I have stated it, the wool industry is the only one which can be said to be adequately organized for this purpose. This evening, then, I propose to present some comparisons of these industries from this viewpoint. It will only be possible to present a limited picture, concerned principally with the marketing section of the operations, and even then only on a broad basis. In other words, this is no attempt at an exhaustive examination. It does, however, put forward some proposals ; that

(1) The wool promotion scheme can be used as a basis for a project for dairying.
(2) A Commonwealth survey of potential meat production should precede any promotional campaign for that commodity.

* Presidential address to the Victorian Branch of the Australian Institute of Agricultural Science on 2nd May, 1947.

(3) In some ways there is need for a new outlook on wheat.
(4) Promotion in general depends on some freedom of trade. There is evidence, however, of a danger that primary products may become mere instruments of fiscal policy.

What Promotion Means in Marketing.

In the marketing sphere " promotion " is the appropriate word to describe that group of activities variously known as advertising, publicity and so on. These terms are unfortunate because in the first place they are inadequate and, more important, their use reflects a lack of appreciation of the real needs of any particular primary industry and the problems involved. For instance, an " advertising campaign " for meat was recently mentioned as a project for which we should be preparing. Similar comment has been made in respect of butter and, of course, the term " wool publicity " is well known. The fact is that in all three instances advertisement or publicity in the limited sense of these words would be wholly inadequate, would indeed involve considerable waste of money. On the other hand, promotional methods, specifically adapted to each product and in accordance with the general pattern of production and marketing in each industry, are vital.

In 1936 the Commonwealth Parliament passed the Wool Publicity and Research Act, establishing the Australian Wool Board to carry out publicity and foster research on behalf of wool and imposing a statutory levy on every bale produced to provide the necessary funds for the work. For various reasons, this was replaced by a new Act in 1945 called the Wool Use Promotion Act. The difference in the name is of great significance ; promotion sells wool, publicity doesn't. There are household words such as wool, wood, coal and so on, the marketing of which is wholly unaffected by the mere publicizing of the word. And into this group fall the major Australian primary products. That is the first point to remember ; there is no simple effective method of advancing sales.

You may remark that after all this comment is concerned merely with the meaning of words, but in promotion words assume very great importance. You may have heard an advertisement from a well-known firm for wine vinegar. But the word " vinegar " literally means the product of the grape. Apparently the industry allowed the maltsters free use of the word when the first malt vinegar was marketed and thereby lost a priceless asset while saving the maltsters an incalculable amount of money which would otherwise have been necessary to put their product on the market under a new name. In more recent times a similar threat was made to wool when terms such as synthetic wool and so on were introduced to describe some artificial fibres. Probably owing to the introduction of labelling legislation in the United States, and the threat of it in other countries, such terms appear to be going out of use. Otherwise we might now be in a position in which we should have to talk about " sheep's wool ". Protection of the names of products is of course an important phase of promotion.

Time to Prepare.

Every primary industry presents a different canvas requiring an appropriate pattern for promotion. You will appreciate that at the moment, when acute shortages of food are threatening humanity in many countries, any promotional work on behalf of the sales of such products would obviously be out of place. At the same time, one assumes that in a few years these shortages will have been surmounted and the need for promotion will arise. The present, then, is the time to prepare for this work.

One Feature in Common.

The four major Australian primary industries have one important feature in common—a surplus production above the requirements of the Australian market

which must be sold overseas. These surpluses vary from 90 per cent. in the case of wool down to 20 per cent. of the meat production. But although this common factor is important, for it immediately involves promotional methods on an international basis and dependent on international trade, it does not mean that these industries are confronted by anything like a common situation or a common problem ; in actual fact the situation confronting each differs in many major points for which any promotional organization must have the keenest regard.

In all four instances, however, export surpluses mean that promotion must be carried to overseas markets and to make any impression on these markets considerable expense is involved. An even more important point is that all four industries require promotional methods modified according to international marketing policy.

Organization.

As I have remarked, the advancement of primary products requires supporting organization right through to the point of retail sales. In short, the organization would provide for the following :

(*a*) First-class research and extension services to assist the producer.

(*b*) Adequate research and advisory services at the stage of further treatment or manufacture as in textiles and dairy products.

(*c*) A specialist promotional organization with (1) a section including promotion experts, trade liaison officers and officers conducting consumer market research ; (2) advertising agents ; (3) statistical services ; (4) economics services ; (5) news services ; (6) as in the case of wool, provision for certain Commonwealth extension work such as production of films for growers and so on.

Such an organization must work in close co-operation with Federal and State research and advisory services and, as well, it must preserve a direct link with the general body of growers. In these circumstances and because it will spend growers' money, the promotional organization should virtually be one of growers' representatives. That principle has been recognized in the case of wool, and present organization of the Commonwealth Marketing Boards for other industries would provide for it too.

Only the wool industry has its own specialized organization for promotion, while a separate organization, the Australian Wool Realization Commission, handles the marketing of the clip. In each of the other three industries marketing boards have been established. Two of these—the Australian Meat Board and the Australian Dairy Produce Board, engaged in limited advertising schemes before the war and clearly would be the organizations to undertake promotion in future.

Effect of Marketing Policy.

The effect of marketing policy on promotion varies in importance according to individual industries.

Wool is sold at auction on a free market and this automatically leads to the heart of the wool promotion problem—the need for unfettered international trade. True it is that a promotional organization can hardly hope to dictate that condition but by keeping its product in the limelight and by continually presenting the factual position of the industry, together with its world importance, in the right quarters it can do a great deal towards the establishment of a favourable terrain for its operations.

Before the war our surpluses of beef, mutton and lamb were marketed in Britain under a quota system decided under the Ottawa Agreements. At that time there was a marked division of opinion within the industry as to whether a quota or a preferential duty should be the objective. Finally, weight of opinion favoured the quota—a decision which as far as lamb was concerned would never have won the approval of a competent promotional organization with its links with pasture

improvement services unless, of course, the quota was so large as to allow expansion of the industry beyond anything to which one could look forward. As it turned out, the rapid expansion of the fat lamb industry occurred in conjunction with pasture improvement, and in 1937 it appeared that the quota would be exceeded in the following year. Drought intervened however, and the next year, when the quota would certainly have been inadequate, the threat of war and its ultimate declaration just after the end of the quota year changed the situation. At that time, the effect of an unmarketable surplus would have been acute in the meat industry because under the auction system prices over the whole production during the export season would have slumped. Meat is one of the Empire products essentially concerned in such decisions as arise out of the Bretton Woods agreement.

Butter is favoured by a British preferential duty of 15/- per cwt. and is another product which may be affected by that agreement.

Wheat, of course, presents a special case, in view of the apparent ease with which the world can grow enough for its requirements in normal times. Marketing policy, has, therefore, turned to agreements for restriction of areas and so on. Admitting the difficulties of promoting what already is considered the staff of life—even admitting that in some countries the long-term need might well be for an increase in supply and consumption of the protective foods such as animal fats rather than carbohydrate—I still feel that there is room for a more positive marketing policy for wheat in the years ahead.

I do not propose to enter further into the innumerable details of marketing in these industries. Sufficient has been said to indicate the difference in the marketing situation confronting each product. In general, it is true that the freer the market the more opportunities there are for promotional measures.

Finance.

Any action designed to influence the habits and opinions of millions of people in a comparatively limited period must be costly and promotion is indeed an expensive operation. Fortunately, the costs are not entirely borne by the producer for the retailer is a willing co-operator in this work and various classes of manufacturers of their own volition, or in co-operation with growers' organizations, are also prepared to give substantial aid. Acceptable and important though the contributions may be, formidable amounts of money are inevitably required from the producers themselves.

Dairying, however, presents a special claim for State support, because, as it happens, dairy products are included among the protective foods, the increased consumption of which is needed to provide an adequate diet for large sections of various populations. Efforts in this direction, therefore, are properly considered as part of a national campaign against malnutrition.

Collection by levy on growers has been the accepted method of providing funds needed for promotion of primary products. The extent of the industry's ability to do this over the whole production so that everyone engaged contributes proportionately to the quantity of the product he produces is a most important factor.

Because of its nature and its marketing system, collection of a levy over the whole of the Australian wool clip is a simple process. In dairying, it is also possible to do this on all butter and cheese produced and on processed milk products. Whole milk and milk for ice-cream may represent a more difficult problem.

Wheat under a marketing board offers no barriers to the imposition of a small levy over the whole Australian marketed crop.

On the other hand, opportunities for promotion of meat are limited by the difficulty of collecting a levy on the proportion consumed in Australia, representing about 80 per cent. of the total production. It may be argued that as the levy would be spent on the overseas market it should be provided only from export meat. At the same time, everybody in the industry fully appreciates that export demand

provides the floor to the market for the whole production sold at least during the peak period of marketing and often at other periods as well. Whether any particular stock go for export or home consumption, their owner gets the benefit of the security which a buoyant export demand gives and, therefore, might be expected to contribute his share to maintaining that demand. The difficulty is, of course, that not only are stock sold at innumerable auction centres throughout the Commonwealth but sales are made privately as well as direct to meat works on a weight and grade basis.

Let me emphasize that, although the total funds needed for promotion in these industries may be large, they would represent only a trifling proportion of the value of the production. For wool promotion, £300,000 a year is being collected by a levy of 2/- a bale. I do not propose to suggest what the levies should be in the case of other products, for this is a matter which should be decided by the producers themselves. As far as meat and dairy produce are concerned, funds were set aside and used for advertising before the war and I have no doubt that the producers will fully agree that funds should be set aside for promotion. However, I can point out that it is useless to expect any material benefit from campaigns that are not planned and financed on a scale appropriate to the magnitude of the undertakings involved.

I have never heard of any proposal for a fund for the promotion of Australian wheat—a task which presents forbidding features. Whether it is impossible remains to be seen.

Two Classes of Competitors.

Having discussed the meaning of promotion, its organization, finance and so on, we can now proceed to a brief examination of the needs of individual industries.

It is apparent that primary products can be broadly divided into two classes :

(1) Those competing principally against substitutes of different biological or organic origin.

(2) Those competing principally among themselves.

The first class includes wool which is largely concerned with the competition of artificial fibres, and butter with which margarine is normally in violent competition.

Meat and wheat, on the other hand, are in a second class. Australian lamb competes against New Zealand lamb and Australian beef competes against Argentine beef. Australian wheat is in competition with Canadian and American grain.

This division leads automatically, I think, to a proposal for the dairying industry.

The woolgrowers realized from the beginning of their movement for world wool promotion that the situation demanded a united front on the part of all the major wool-exporting countries so they launched the movement on an Empire basis.

Australia, New Zealand and South Africa combined to form one international organization supported by combined funds to fight the common threat of artificial fibres. This means that financed by each country according to the amount of wool it produces, the fund that can be made available for international promotion amounts to about £400,000 a year. That estimate is made allowing £60,000 of the Australian fund of £300,000 for promotion on the home market and £240,000 for overseas use, and as Australia contributes about three-fifths of the international fund, the other Dominions together would provide £160,000. As one organization making artificial fibres spent £500,000 a year on similar work before the war, the amount for wool promotion is not excessive. But it does represent a real fighting fund to be administered with all the great advantages of simple direction compared with the dissipation of effort and the lack of momentum from which separate schemes would undoubtedly suffer. Let us not forget too that the ultimate objective of the wool promotion scheme is to include all wool-producing countries within the ranks of its contributing members.

It seems to me that the Australian dairy farmer might well consider the adoption of a similar scheme, designed against margarine. Before the war Australia advertised its butter, New Zealand did the same for its product, and so did Denmark. The

salient point is that these efforts were simply competitive among themselves, whereas they could have been combined in a united campaign against their common rival. In the war period two great developments in production of vegetable oils overshadowed all other movements for the production of fats. These developments were the rise of the soya bean industry in the United States and the expansion of production of oil from sunflower seed in the Argentine. In addition, there is the recently announced British plan for the cultivation of three million acres of peanuts in Africa for a similar purpose.

In these circumstances, can the dairy farmers continue to afford competitive promotion among themselves? Is there not a good opportunity of combining forces as the wool growers have done? I see no reason why Australia and New Zealand should not make a beginning in this way and an approach might also be made to the Danish farmer. Numbers of other countries also supplied Britain with butter before the war and the objective would be to consolidate all these suppliers in one international organization for the promotion of dairy produce. In this way funds could be established on a scale far more adequate to the job, and efforts could be concentrated into one solid drive.

It takes little time to make these suggestions, but to carry them out may be a long and involved process. The first move for world wool promotion was made in 1931 when an Empire wool growers' conference in London passed a resolution favouring such a project. Five years later the Australian Wool Board was established; in 1937 delegates from New Zealand and South Africa at a conference with the Board in Melbourne agreed to the formation of the International Wool Secretariat which was established in that year and was actively engaged in wool promotion in 1938—seven years after the original move was made.

Making use of the experience of the wool growers and appreciating that throughout the world farmers have managed to get much closer to each other in the last year or two, a similar international organization for the promotion of dairy products should be formed more rapidly. It will probably be needed at the end of say three years, a period long enough for its establishment.

Australian Markets for Dairy Produce.

In suggesting such international advancement of dairy products one does not overlook the opportunities for promotion on the Australian market. Over the last eight years about 72 per cent. of the total Australian milk supply was used in the production of butter, 6 per cent. for cheese, 5 per cent. for processed milk products and 17 per cent. for other purposes—presumably representing principally whole milk for human consumption and for ice cream. In 1938-39 the quantity used as whole-milk was 165 million gallons, and this increased steadily through the next seven years to 207 million gallons, or a rise in consumption of more than 20 per cent. The reasons for this increase doubtless include the higher purchasing power, the consumer subsidy, and some educational propaganda. At little more than half a pint a day per head of population, consumption of milk still remains too low for adequate nutrition of large groups of the population and it is clear that the Commonwealth and State Governments could well throw their weight behind a national campaign for milk consumption at the appropriate time. New South Wales already is operating a scheme on a useful scale. In turn producers have an equal duty in ensuring that there is general observance of hygienic standards in production and retailers a similar obligation in distribution.

The industry is well aware of these opportunities in the Australian market and there is little doubt that action will be taken when the time is ripe. I hope, however, that in doing this the Australian Dairy Produce Board will set up a division of promotion as part of its organization, and I hope too that it will prepare for a combined organization with other countries to undertake the work on an international scale.

Case for a Commonwealth Meat Survey.

It seems to me that before any plans are made for long-term promotion of meat a survey should be made of the meat-producing capacity of the Commonwealth. Few persons realize that in pre-war years before the big decline in stock numbers—our surplus of meat amounted only to 20 per cent. The Rural Reconstruction Commission has pointed out that at the present slow increase in the population, plus 100,000 immigrants a year after 1947, this surplus will disappear by 1961 if production remains unchanged.

Despite these facts, little thought is apparently being given to the situation and in Victoria settlement schemes are being advanced on the basis of dairying without some provision for, say, early-maturing beef cattle. In other words any official movements are away from the production of that commodity of which we are in shortest supply.

Naturally a survey of the nature suggested would include opportunities for beef production in all dairying districts, the chances for more extensive livestock farming in the wheat areas and so on. It would also be related to quality production—a prerequisite to any campaign of sales promotion on the overseas market.

When all of this information is collected the industry will be far better able to embark confidently on general promotion throughout its operations.

The Wheat Problem.

Now for the wheat industry. How to promote the staff of life ? I do not offer any complete plan. I doubt whether such a plan is possible at the present moment. But I am certain that no plan will ever be devised unless the present outlook is changed in some respects. In Australia have we not been rather overwhelmed by the opinions of other countries of the necessity for restrictions ?—so overwhelmed that we have lost a positive approach to the whole question. I suggest that the following should be considered :

(1) In view of the meat situation, an increase in stock raising, of an order not yet known, will take place in the wheat districts with corresponding reduction in areas placed annually under crop.

(2) In the last drought many thousands of sheep owners learnt for the first time that wheat could be fed safely to their stock over a protracted period.

(3) The long-term prospects of the meat industry favour higher prices than in the years before the war and therefore an increased capacity to pay more for feed grain than in the past.

(4) Apart altogether from the pressing needs in periods of acute drought, regular grain feeding under certain conditions and at certain periods may become a more general feature of sheep-raising.

(5) Better nutrition of dairy cattle will call for more grain concentrates, particularly if markets for wholemilk should increase.

The Australian Wheat Board which has been forced to limit supplies of feed grain to 20,000,000 bushels a year must, of course, be acutely aware of the present demand for this purpose. But is there not a clear case for research into economic grain usage in all the livestock industries ? Here is work which I suggest may provide the opportunity and the basis for a positive promotional campaign for wheat. I do not suggest that it is in any sense a complete answer to the problem, but it would provide for a step forward, remembering that the wheat grower cannot indefinitely be asked to provide feed grain at such a discount as obtains at present.

There is one further thought which seems worth mentioning. For many years it has been said that the eastern countries provide a huge potential market for wheat but the low purchasing power of these populations has been the barrier. The same

comment was also made about wool. Nevertheless, the International Wool Secretariat sent a delegation to India this year to make a survey of the long-term prospects for wool in that country. Would not similar action be justified for wheat ?

Instruments of Fiscal Policy.

Finally, I want to direct your attention to a paragraph in a report of the Preparatory Commission set up by the United Nations Food and Agriculture Organization.

In its report the F.A.O. Preparatory Commission noted that a free market in the old sense did not now exist for agricultural products, because governments were generally committed to policies of price regulation and subsidy and controlled international trade. The Commission concluded that the best hope lay in intergovernmental consultations leading to commodity agreements.

Commodities included are wheat, sugar, rice, livestock products, oils and fats, fish, tea, cocoa, timber, cotton and wool. A separate commodity agreement would be made on each of these commodities.

Does this literally mean that, in future, the governments of most countries will tell every individual what he or she will eat ? It is true that free markets for many products do not exist at present, wool being a notable exception, but that situation has not been brought about by deliberate long-term policy. It arose because whole nations were—still are—threatened with starvation, and it was essential that their governments took a hand in getting supplies and distributing them. To suggest that governments will continue to define what people will eat when the present shortages of goods are surmounted seems to me a proposal for a descent down the ladder of evolution to the termites. Indeed, we need only take one step further and differentially feed various sections of the population for certain work and we shall achieve a very fair imitation of a termite colony. In any event, such action by governments would mean that in international trade, primary products could become mere instruments of fiscal policy.

Recently, indignation was expressed at a deal with New Zealand at a price far less than ruling values. The deal was not made by the marketing authorities ; it was made by the Commonwealth Government for some reason of policy. In other words, wheat became an instrument of fiscal policy. Orderly marketing is one thing, but the usage of products to further government policy is another question altogether.

I regret the need to introduce such a political question at this meeting. I do so because I find it difficult to imagine any real promotional organization operating to useful purpose under such a system.

I cannot think that this state of affairs can persist indefinitely, and I believe that it will be rejected by the individual everywhere—grower, consumer, Uncle Tom Cobbley and all.

(Received for publication, 7th July, 1947.)

Agricultural Education

By

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The term " agricultural education " is often used to include both vocational and higher agricultural education. In this article it is used with the meaning implied by either " vocational agricultural education " or " vocational education in agriculture ", no attempt being made to deal with higher agricultural education.

Matthaei[8] distinguishes between extension work and formal teaching, while the Committee on Post-war Agricultural Education in England and Wales[3] uses the terms " non-institutional agricultural education " and " institutional agricultural education ".

Extension Work.

Throughout the world, agricultural education has developed much more along the lines of extension work than in formal teaching. Included under this heading are such activities as the publication of agricultural journals, pamphlets and leaflets, the use of the moving pictures and radio, field days, better farming trains and waggons and many other comparable forms of extension activity.

One of the greatest advantages of extension work is that it is a simple and popular method of conveying to, at least, some members of the farming community the results of agricultural research. Most of these will never again attend school or college and there is really no other way of reaching them, while the numbers involved are so great that any other method would be inadequate. The method has the charm of informality and absence of compulsion. It is generally free of cost. There is also the advantage that extension work programmes are not tied down to curricula and are free from examinations.

On the other hand, it may be objected that in many cases the effectiveness of extension work can only be guessed at. Those of us who have attended field days have often wondered how many of the gathering absorbed even a small proportion of the lessons taught. Undoubtedly, in extension work much effort may be made and expense incurred in securing only a partially effective result.

County Agents or District Officers.

The most striking development in modern times in extension work has been the " county agent " system. Sometimes the agent, or advisory or district officer as he may be called, works single-handed, but in many cases he maintains an office and staff. While such an officer is often responsible for the organization of field days, displays, shows, etc., probably his most valuable work is done by personal contact with the farmer. It may be objected that such a method is slow and expensive in that the officer is conveying information to one man only when he could just as easily convey it to a group. In practice, this objection has very little value. It is surprising how many contacts can be made in a relatively short time. The effectiveness of personal contact justifies the time spent.

It is a fact that in the absence of such an officer much of the work of the county agent is done in the course of other duties, such as the administering of certain Acts, by stock inspectors, dairy supervisors and similar officials.

The agent or adviser system appears to have come to stay and it is along these lines that we may expect the greatest development in extension work in Australia. However, there is a need on the part of the extension worker to be ready at all times to accept and adapt new methods of conveying his message to his public.

Staffing.

Because of the complex nature of the work and the constant need for striving for the greatest possible effectiveness, careful selection and sound training of staff must form the real basis of extension work. To academic soundness must be added the practical outlook, but these are of little avail unless the officer has mastered the technique of effective approach. In addition, it is essential that he should keep in touch with research.

Although, as has already been stated, it is not the purpose of this article to discuss higher agricultural education, it may be remarked that there is general agreement that the basic scientific training of the extension officer should not be inferior to that of his colleagues in the spheres of administration and investigation. In addition, he should have some training in the art of exposition, after which he could enter upon a probationary period as an assistant to an extension officer, spending some of his time at research farms, agricultural colleges and similar institutions. This matter of training is discussed rather fully in the report of the Committee on Higher Agricultural Education in England and Wales.[4]

Formal Teaching.

If extension work has its problems, formal teaching certainly has many more. It is to this form of education that the term " vocational agricultural education " is usually applied. What are the aims of vocational education ? Is it intended to give a boy mere technical training, manual dexterity and manipulative ability, or should an attempt be made to give something much broader ? Can we include in vocational education something of the cultural ?

Generally speaking, there is a tendency to overrate the value of mere technical training and this seems to apply very markedly in young countries such as Australia. Some of the gravest mistakes in education are made when technical training is attempted before a basic education is completed.

General Aims of Education.

Such a consideration leads to an examination of the general aims of all education. Professor Joad[6] suggests that education has a number of ends, of which three are outstanding :

(i) To equip a boy to earn his living.
(ii) To equip him to play his part as a citizen of a democracy.
(iii) To enable him to develop all the latent powers and faculties of his nature and so to enjoy a good life.

Joad is not alone in emphasizing the vocational aim, but his emphasis of the cultural cannot be overlooked.

To the layman in educational matters it must be very confusing to hear discussions about so many " kinds " of education—basic, cultural, vocational, primary, secondary, tertiary, and so on. On the other hand, there is indeed a widespread idea that the type of education given to our young people must vary greatly with their future careers. For example, it was suggested to the writer recently that the education given to a farmer should be entirely different from that of the agricultural scientist. This conception must be strongly challenged. We must think in terms of an educational system which will give to all the same fundamental training in clear thinking and sane outlook on life and the same introduction to cultural, moral and spiritual aims. The divergence, which comes when vocational training begins, is important, but it should not be regarded as the dominant factor.

Teaching of Agriculture in Schools.

It becomes essential to visualize a system of education which attempts to embrace Joad's three aims but it is also necessary to determine the stage before which purely vocational education should not be given. Many enthusiasts advocate

the teaching of " agriculture " in primary schools, but all attempts to do this effectively have failed. Agriculture is not a subject for the primary school curriculum. It is too vast and many-sided, and the child who is still in the primary school is not yet equipped to undertake its study. He should be fully occupied in obtaining the basis of his future education. Still more people urge the introduction of the " subject " into the secondary school, but here again the same objections apply. (The agricultural high school is discussed later in this article.)

There are so many subjects which appear desirable for inclusion in the curricula of our primary and secondary schools that there is a serious risk of overloading them and neglecting basic training. In this connexion Livingstone's comment[7] is most pertinent (p. 28).

" It and similar arguments drawn from the amount of knowledge supposed ' necessary to the modern man ' are responsible for the overcrowded curriculum which leads to intellectual dyspepsia, hopeless malnutrition, and often to a permanent distaste for knowledge and incapacity to digest it ; to the plastering of ideas and facts on the surface of the pupil's mind from which they rapidly peel off ; to mistaking information, which never becomes an organic part of his experience, for education which is absorbed by his mind and transforms it. The test of a successful education is not the amount of knowledge that a pupil takes away from school, but his appetite to know and his capacity to learn. If the school sends out children with a desire for knowledge and some idea of how to acquire and use it, it will have done its work. Too many leave school with the appetite killed and the mind loaded with undigested lumps of information. The good schoolmaster is known by the number of valuable subjects that he declines to teach."

Rural Bias.

Many of the enthusiasts who advocate the teaching of agriculture in primary schools are really anxious to develop what has been described as the " rural bias ". In so far as it seeks to make use of the child's rural background as an aid to teaching by linking subjects taught with the atmosphere of his daily life, rural bias must be commended. It can and does make education much more real.

Sometimes enthusiasts go further and claim that not only should the rural bias counteract the urban bias of so much of our education system, but it should assist in preventing drift to the cities. Such carrying of rural bias to the extent of giving it a vocational aspect has led to opposition by rural dwellers themselves. As far back as 1929, the National Union of Agricultural Workers of England and Wales stated : " We are entirely opposed to giving an agricultural bias to the teaching of young children. We are utterly opposed to directing education of village boys and girls consciously towards providing future workers on the land."[5] (p. 52).

The same memorandum stated : " Certainly up to the age of eleven the child's education should have no specific reference to any particular future occupation."

In this connexion it is interesting to read (on p. 35) the following in the report of the Committee on Post-war Agricultural Education in England and Wales[3] (published in 1943) : " We do not, however, consider that the teaching of science in relation to the principles underlying the life and work of the countryside ought to be confined to senior schools in rural areas. In our opinion, such teaching is of the greatest importance in the general scheme of cultural education for students attending schools in urban and rural areas alike. It is essential that every citizen should be familiar with the broad scientific principles relating to the production, handling and use of the various common articles of food to be seen on his table from day to day. It is not with any idea or intention of persuading the child to follow agricultural pursuits that we express these opinions for we think that there should be no attempt at any form of vocational training for children below the age of 15, and that every child should be left as free as possible in the choice of his or her future occupation, whether it be in industry or commerce or in any other direction."

Education in Three Stages.

This is in accord with the considered opinion of experienced educationists that we should plan our educational system in three stages and that vocational education should not commence until the tertiary stage is reached.

In vocational education in agriculture, Australia has relied chiefly on the agricultural college. Lower grade vocational schools which are a feature of agricultural education in Europe[8] are not found here. In their early years our agricultural colleges took up the student's education at the conclusion of his primary course. Nowadays some secondary education is required as a prerequisite, but the colleges are not yet purely tertiary institutions. When they do assume the latter rôle, students will enter them at the age of 16+ with Leaving Certificate.

Aims of the Agricultural College.

At this stage, it may be worth considering what the particular aims of agricultural college training should be. It is a matter of common knowledge that after passing through the colleges students find their way to many callings associated with agriculture. While some engage in practical farming in various capacities, others become field officers, herd testers, dairy supervisors and the like. Others again become technical officers in research work, while quite a number enter commercial life with firms handling agricultural products and supplies. While the primary aim of each agricultural college has always been to train its students for a farming career, there is no escape from the responsibility of training some students for these other callings. At first sight, this constitutes a problem in that students should be trained somewhat differently according to the specific vocations which they are to follow. This problem is more imaginary than real. Carried to its logical conclusion this point of view would result in an absurd attempt to train each would-be farmer for the particular farm to which he will ultimately go. Farms differ so greatly and problems of management vary to such a great extent, that we must abandon any idea of narrowing the training for specific ends. Nor should we attempt to train for specific sectional vocations. The potential factual content of a curriculum is now so great that we are forced to select certain fundamentals for teaching, relying more and more on developing in the student the right attitude of mind and on giving him such basic skill and knowledge that he can himself acquire the particular information that he needs.

It is of the greatest importance that the diplomate of the agricultural college should be receptive to new ideas and yet sound enough in judgement to weigh advantages and disadvantages. He should have an enquiring mind and possess sufficient initiative to investigate and seek out his facts. Further, he should know where to go for information which he cannot find unaided, and having found and assimilated his facts, he should be able to apply them in both management and planning. A training designed to produce this result must be regarded as suitable for whatever branch of agriculture the student is going to enter. If this broad conception of the aims of the agricultural college is accepted, details of curriculum assume a lesser importance. It is preferable to teach a limited amount well, rather than overload the course and have quite a lot of it badly taught. Experienced educators know that the character, personality and skill of the teacher are much more important than details of the factual content of his subject.

Specialization.

All who are engaged in the work of agricultural education are continually confronted with the demand for specialization. Most frequently this is a case of desiring to run before the art of walking is mastered. Very naturally the student cannot get the broad view ; he has not yet realized the need for sound and thorough basic training. In practical agriculture, the degree of specialization which is desired can often be best achieved by experience after leaving the college and by consulting

appropriate literature. However, in some cases the need for specialization is real but it should never be attempted until the foundation of basic training is well laid.

The College Farm and Practical Work for Students.

From the outset, agricultural colleges in Australia have had well-equipped farms, generally large. (To-day, they range from 6,048 acres at Dookie to 1,692 acres at Gatton.) In an attempt to " combine theory with practice ", students spent every second day on the farm doing the normal farm work. In most cases, the organization of the time-table was extremely simple. This " day in, day out " system still persists in some of the colleges, but it has always been subject to some criticism. On his return from U.S.A. in 1918, Richardson[9] reported (p. 18): " No manual farm work is given in the agricultural college in the United States. The universal opinion is that the students' time is too valuable to spend it in acquiring manual dexterity and skill in manipulative farming operations . . . They do not come to the colleges to learn how to do manipulative farm operations but to acquire a knowledge of the applications of science to agriculture, and technical knowledge which they cannot get on the home farm."

The question of practical work cannot be quite so lightly dismissed. Pedagogically the system is ideal. In a most favourable environment the training of the student develops along parallel lines. The average lad revels in the farm work which relieves for him the tedium of lecture room and study. Along with his physical development, there is mental growth, together with a building up of poise, self-reliance and a spirit of enterprise. The periods spent on the farm allow for the time factor which some students find so important in the absorption of what is taught in the classroom.

It must be admitted that when the Richardson report was written some of the colleges were overemphasizing the practical side, with the result that their diplomates had neither the necessary scientific training nor the right outlook. This showed up strongly when they were working side by side with better trained men as field officers and the like.

However, there is a very definite limit on any farm to the number of students who can be given practical training of real value. Beyond that limit the instructor finds that he has to allot time-killing jobs to students, or alternately several students must be assigned to a task which would be better done by one. When this happens, the practical work becomes worse than useless.

Such a situation can be met by a greater use of demonstrations, in which small groups of students are given intensive instruction in various farm operations, in stock-judging, in practical study of marketing, and so on. As the numbers of students in our colleges increase, this development must come. Sheer weight of numbers will force the change.

Teaching Methods.

This discussion leads naturally to a consideration of teaching methods. It must be admitted that formal lecturing and laborious writing of notes by students have featured largely in our colleges. Methods as well as facts should keep pace with the times. With less manual drudgery on the farm should go less " lecturing " in the class room, but there must come more project work on the part of the students, more discussion groups and more extensive use of the moving picture and the film strip. The farm will be to the lecturer in vocational subjects what the school chem. lab. is to the teacher of chemistry.

With less farm work and improved methods of teaching the course can be either shortened or raised in standard. Shortening would provide the opportunity for students to proceed to a private farm for practical experience, while raising the standard would enable the colleges to meet some of the criticism which has been levelled at them in the past. Here it may be remarked that many of the critics did

not appreciate the difficulties under which the staffs were labouring. The wide variation in the educational standard of entrants upon the course resulted in a somewhat lowered diploma standard and an unduly large wastage rate. When Leaving Certificate is insisted upon as the entrance standard, the course at the agricultural college can be both shortened and raised in standard.

Location of Colleges.

From time to time, demands are made by various organizations for the establishment of new agricultural colleges in certain districts. For example, there is the familiar demand for dairying colleges in dairying districts. In many cases this is merely the same old cry for specialization, without the essential fundamental training. As such it should be opposed. But it raises the question as to whether, say, dairying can be effectively taught at an agricultural college which is not in a dairying district. The existing colleges have well-equipped dairy branches; they are competent to teach, and do teach, the practices and the underlying sciences of modern dairying. If we accept the view, already discussed, that the most important aim is to train the student in methods of systematic thought and to give him the right attitude of mind and a power to attack problems, the actual location of the college is of minor importance. If on the other hand the location is regarded as a dominating factor, we shall reach the absurd situation of having small agricultural colleges dotted all over rural Australia.

Agricultural colleges are very expensive to set up and maintain. Surely it is wiser, certainly it is more economical (for the present at least), to concentrate on a few and make them really worth-while, rather than dissipate our resources in an attempt to achieve a doubtful advantage.

The Agricultural High School.

So far, no mention has been made of the agricultural high school. The proper function of a high school is to provide secondary education. A very desirable arrangement would be one in which the high school provided no vocational training, leaving the latter to be given in the tertiary stage. In country areas, the rural bias could be continued from the primary school and further developed, and the school could set itself deliberately to prepare for an agricultural college course those pupils who desired vocational education in agriculture.

But we must face up to the fact that, unless a system of adult education is developed more rapidly than now appears probable, the education of thousands of our boys will not go further than the high school. If they do not receive some vocational training at that stage, they will get none at all. It is here that the agricultural high school can fulfil a useful function, provided that certain essentials are observed. Experience in Victoria showed that such a school must be suitably staffed and must not offer purely academic or non-vocational courses in competition with the agricultural course. Since it is essentially a secondary course the curriculum of the latter will naturally include, in addition to the sciences, some English, mathematics, geography, and possibly history, all taught with the "rural bias".

This means that the agricultural high schools would be quite distinct from the ordinary, or non-vocational high schools. It is most desirable that they should be residential and that they be located to provide an adequate coverage for each State.

There is a distinct difference of opinion on the question of providing farms at such schools. In a course which is still largely secondary there can be little opportunity for teaching practical agriculture. In any case, the numbers are likely to be so large that the allotment of a modicum of useful farm work to each student will become a major problem. The Rural Reconstruction Commission,[1] while recognizing the advantages in the attachment of an agricultural high school to a large working farm, was very definitely of the opinion that "a farm is not a necessary part of an agricultural high school for the purposes of teaching practical agriculture"

(p. 48). As an alternative, the Commission suggested enlisting the sympathy and interest of the better farmers in the neighbouring district and using their farms for demonstrating the best methods in farming.

Earlier in this article mention was made of the problem of selecting and training staff for extension work. The same difficulties, and more, are experienced in staffing our agricultural colleges and agricultural high schools. It must be admitted that in the past the greatest staff need in our colleges has been the trained teacher; on the other hand, the high schools were staffed with trained teachers but were weak on the scientific and vocational sides. It is a reasonable assumption that if the colleges had had more trained educators on their staffs, there would have been fewer of the "unfortunate incidents" mentioned by the Rural Reconstruction Commission.[1] However, a discussion of the possible and desirable methods of training teachers is outside the scope of this article, but it may be observed that as with extension workers there is the very real need for the teacher to keep abreast of research and practice.

Relationship between University, Agricultural College and Agricultural High School.

This discussion of the agricultural college and the agricultural high school may well be concluded with some consideration of their relationship one to the other, and to the university. Under existing circumstances many pupils of the agricultural high school will go no further, but the curriculum can be so designed that it is a preparation for either the agricultural college or the university. Most of the students at the agricultural colleges will go no further, but here again there is no reason why the course cannot be a preparation for the university course, or indeed, constitute the more practical portion of the latter. Some of our Australian universities accept the college diploma as a qualification for matriculation and grant to diplomates certain concessions in the degree course in agriculture. Thus in Melbourne a student with the Dookie diploma can usually complete the degree course in three years instead of four.

There should be the closest possible association of university and agricultural college. This is achieved best when the university student in agriculture spends portion of his time at the college and receives instruction in some subjects there. This practice is in operation in some States. For example, in Victoria, university students in the second year of the degree course spend the whole of the college year (which is longer than the university year) at Dookie. On the other hand, South Australia has recently adopted a scheme whereby university students spend a portion of each week at Roseworthy in their second, third and fourth years. Both systems have their advantages, but the South Australian results in a greater strengthening of staff at the college (since instruction has to be given in the third and fourth years) together with greater improvements in equipment.

Adult Education.

It appears that to many people adult agricultural education and extension work are synonymous. Is there no place for formal teaching in our adult education? Throughout the world there is a well-defined upsurge of post-war interest in adult education generally. Naturally almost every writer on the subject turns to the Danish People's High Schools. These are essentially non-vocational, yet it is generally admitted that they were the greatest single factor in the very great improvement which took place in Denmark's agriculture, and in changing that once poverty-stricken country to a progressive and prosperous democracy.

The Rural Reconstruction Commission[1] reports (p. 67) that "so far there is little demand for adult education among farmers on a scale in any way comparable with that shown by Danish farmers in their Danish folk high school movement". The greatest obstacle to education, particularly adult education, is that no one can

appreciate its advantages until he has been educated. The difficulty is to get students in the early stages. The Danish People's High Schools received their initial impetus from the patriotic motives which inspired their founders—the desire that their fellow countrymen should be imbued with a spirit of patriotism and a pride in Danish way of life, culture and achievements. This was to provide a counterpoise to insidious German influence and propaganda. Even with such a powerful motive there were, in the early stages, many difficulties to be overcome.

These people's high schools are residential and no one under 18 years of age is admitted. These schools " awakened in young men and women a yearning for knowledge and a desire to work ; the character of the pupils was strengthened, and they left the schools with a much enlarged outlook on life. To satisfy its yearning for knowledge a current of youth flowed from the folk high schools to the agriculture schools, and when it afterwards passed out into life it did so with a strong feeling of fellowship and a desire to work for common progress. Youth thus gained some of the qualifications necessary to the success of a co-operative movement."[2]

The Danish system does not exclude vocational education. To quote Livingstone,[7] " Denmark has agricultural and dairy schools, and they are widely attended. But the P.H.S. came first and supplied the driving power " (p. 57).

In Australia, formal teaching has figured only slightly in adult agricultural education. There have been occasional short-term residential " farmers' classes " and " women's classes ", also many isolated lectures, but the latter could be classed as extension work.

The eight weeks' intensive residential course in the " Principles of Farming " now being given throughout Australia to potential soldier settlers is far ahead of anything hitherto attempted in this country. This work is likely to be continued for some years. At the conclusion of the work of training for soldier settlement, there will exist an organization which will have been well developed and thoroughly tested. This could be used as the basis of a system of adult education which could be widened and developed to include cultural as well as vocational aims.

Assuming that such a scheme is adopted with a minimum age of 18 years, what of the gap between leaving school and admission to the adult college ? This is just where the correspondence course and the senior Young Farmers' Clubs have their best opportunity for useful work. Fostered by an organization which would be specially developed for the purpose and which would function chiefly through the local district officers, the work of senior young farmers' clubs would not only be valuable in itself, but would serve as an excellent preparation for the adult residential course.

References.

1. Australia : Rural Reconstruction Commission, Sixth Report. Canberra : Government Printer, 1945.
2. Begtrup, H. : Quoted (p. 57) by Livingstone, Sir Richard, in " The Future in Education ". C.U.P., 1941.
3. Great Britain : Post-war Agricultural Education in England and Wales, Report of Committee on. H.M. Stationery Office, 1943.
4. Great Britain : Higher Agricultural Education in England and Wales. Report of Committee on. H.M. Stationery Office, 1945.
5. International Labour Office : Vocational Education in Agriculture. Studies and Reports, Series K (Agriculture), No. 9, 1929.
6. Joad, C. E. M. : About Education. London : Faber, 1945.
7. Livingstone, Sir Richard : The Future in Education. C.U.P., 1941.
8. Matthaei, L. E. : Education in Agriculture. International Labour Rev., xx, 5 : 666-689, 1929.
9. Richardson, A. E. V. : Agricultural Education and Agricultural Development in America. Melbourne : Government Printer, 1918.

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A Neglected Rural Resource—Farm Youth

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" Older rural youth appear to be the most neglected human resource of rural life."—Howard Y. McClusky, Assistant Vice-President, University of Michigan.

Although this statement was made about rural youth in America, it appears to be equally true of youth in Australia.

It is probable that many would refute this statement, quoting cases of young farm people who have " made good " both economically and socially, because of good home training, an excellent local school, a local government agency which believed in youth encouragement, the influence of young farmers' organizations, progressive church clubs and so on.

Those who believe the statement to be true could quote an equal number of cases of rural youth who have limited initiative, economic and social advantages because no one has ever bothered about them.

The fact is that so little is known—really known—about rural youth on an average in Australia that almost anything we say about them could be true.

Studies in Victoria.

It is because of a general lack of knowledge of the actual human side of farming that the Melbourne University Agriculture School has given rural sociology a major place in its programme of research. In a foreword to an excellent survey entitled " Wheat Farms of Victoria ", by A. J. Holt, Professor Wadham points out " we still know remarkably little about the typical conditions of agricultural production in Australia. This ignorance baffles many of our attempts to solve our problems, especially our economic ones . . . Economic information including estimates of cost of production is certainly valuable ; but the sociological side—knowledge of the farmers' standard of living and his relations to the community is no less important."

Melbourne School of Agriculture has conducted four surveys : one dealing with a number of rural towns of the State, one the dairying industry, a third the dried fruits industry, and a fourth with wheat farms.

Two of these have been published, namely " Country Towns of Victoria ", by Mr. and Mrs. A. J. McIntyre, and " Wheat Farms of Victoria ", already referred to.

A further survey of a district area—the Shire of Whittlesea—is at present being carried out.

While these surveys do not deal specifically with youth, much enlightening information is available from them which gives the sociologist food for thought as to the present position and the future of young people in the country. In " Wheat Farms in Victoria " details of farm families interviewed are given (descriptive and tabular). These include the number, age and sex of children, the percentage remaining on the farm after schooling, those who go to higher education, etc.

Interesting facts regarding payment or non-payment of family labour are presented, an important point since uncertainty as to what remuneration the youth will receive for farm or house work appears to be responsible for much dissatisfaction among farm youth. Farm housing is comprehensively discussed, while an interesting chapter on " attitudes " throws considerable light on what the farmer thinks about such things as hours of work, leisure, education, township people, Sunday observances and so on. No doubt the attitude of parents strongly influences the opinions of youth and may be responsible for placid contentment with rural life or a complete revolt against existing conditions.

How Can the Problem be Solved ?

For those concerned with the young people of the country, the problem involved is a complicated one, and many opinions have been expressed as to what factors must be considered in an endeavour to broaden the horizons of the grown-up boys and girls who will normally spend their lives in the country. The formal educationist maintains that smaller classes in country schools, better school equipment, more teachers and better pay for them, or the consolidation of schools would bring about a rural renaissance of untold proportion. The nutritionist declares that a wider general knowledge in the country of natural feeding of infants, followed later with varied balanced meals is one of the greatest factors in producing virile and intelligent young men and young women. Some clergy believe that if all church services in the country were crowded with eager young seekers after spiritual food and if all church functions were equally well attended, then rural youth would be on the high road to success and happiness.

The home scientists emphasize the need for the reduction of household drudgery by the installation of good water supplies and various other labour-saving amenities. This, they believe, creates a more kindly attitude towards the country than exists in the household in which the woman works unceasingly with poor equipment and " only two hands to do everything ".

Others suggest that better transport and communication facilities, more and efficient medical services and hospitals, libraries, community centres, swimming pools and sporting clubs will create contentment in rural youth.

The economist and the agricultural extension officer discuss the lowering of costs of production, combined with increased efficiency of farm operations as the solution of the major problems of the farmer and his family.

The Rural Reconstruction Commission found that the majority of those who gave evidence as to the improvement of rural amenities, considered that the extension of electricity into farm homes would go a long way towards creating contentment in those homes.

Need for More Surveys.

No single factor is likely to bring about an all-round improvement in the conditions and outlook of farm dwellers. For this reason it is suggested that more and varied surveys are essential to add to our knowledge of the fundamental problems involved in any effort to improve the economic and social conditions of the young people who are the future farmers and farm women.

We know so little about the young men and women in any given district or any given industry—What is their educational standard ?—Why do they leave school when they do ?—What do they think about, talk about, look forward to ?—How are they housed ?—What degree of privacy have they in their homes for study and the cultivation of hobbies ?—What are their recreations ?—What financial reward do they receive for the work they do ?

More well planned surveys, carried out by trained people who are interested in the farm population as human beings, would help in planning future extension projects—especially projects for farm youth.

Who Should Conduct the Surveys ?

Just what agency should be responsible for rural surveys is questionable ; opinions would naturally vary as to whether such work should be undertaken by Departments of Agriculture or by University Faculties.

It has been suggested that groups of students (agriculture or social science) might undertake such surveys during the vacations. This would be difficult unless the students had some knowledge of the necessary approach to farming people. The average farmer would not be likely to appreciate answering questions submitted to him by young and inexperienced people. The ideal surveyor would appear to

be the extension officer who is well and favourably known in a district. There are, however, few busy extension officers who could find time to carry out this form of investigation, unless relieved for the time being, of ordinary responsibilities.

It may be possible for students in their final year in the agricultural science course or for the young graduate with suitable financial assistance to tackle this problem seriously with a view to specializing in rural sociology.

It is regrettable that the social or human side of agriculture does not receive more attention in our agricultural science courses. Few undergraduates—other than those who have a farming background, appear to give more than a passing thought to the farmer and his family. Students have limited time to devote to a consideration of the farmer's home, his social interests and the sort of life his children live, since such aspects of the farm problem receive little attention in the curriculum.

As most graduates of agriculture from universities and many holders of agricultural college diplomas are working either directly or indirectly on problems affecting the economic efficiency of the farmer, it seems reasonable to suggest that their training should include some knowledge of the farm family as a social unit.

Even a short course of rural sociology would be useful, and might help the young scientist in cultivating the right approach when he must meet the farmer on his own ground.

A knowledge of the social side of agriculture might reasonably be expected to create in at least a percentage of the students a desire to specialize in agricultural social problems.

With the growth of extension services in State Departments of Agriculture, the need for officers with a knowledge of human as well as agricultural sciences will become more apparent.

Progress in New South Wales.

The N.S.W. Department of Agriculture is gradually building up a useful service through its Division of Information and Extension Service, which tries to assist the farm family to appreciate the importance of rural citizenship. Those responsible for the agricultural bureau organization in this State and those who have built up schools of citizenship for country youth, have had to learn by experience the significance of the farm family and especially of farm youth, in the rural social and economic sphere.

The schools which have become a feature of the extension work of this department offer informal training for young people, sometimes in their own district, sometimes at one centre for State-wide representatives, in a variety of subjects which imply better community progress and understanding.

But however effective such schools may be, a more complete knowledge of the needs of country youth would help in the planning of programmes from district to district, for both youth and adult extension activities.

It is certain that a wider knowledge of sociology on the part of future extension officers and careful surveys of the social conditions of groups of farm families would inevitably lead to better planned extension programmes with an ultimate broadening of the outlook of the farmer and his family.

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The Fifth Report of the Rural Reconstruction Commission

RURAL CREDIT.

No feature of Australian agriculture has stood in more urgent need of investigation than the Rural Credit system. The economic hazards of the not-so-far distant depression years threw into sharp relief the faults inherent in the existing sources of supply of Rural Credit and made it clear that certain major modifications would be necessary before long. However, the processes of change were slow to work themselves out, and at the outbreak of war no great improvements had been made.

Agriculture as an integral part of the economy suffered all the inconveniences, all the adjustments made necessary by total war. But its importance in such a mighty effort was recognized and it received much help not usually afforded it in times of peace. In a sense, the war temporarily isolated agriculture from long-term trends and developments, but it now faces a return to a condition of world competitive markets and all the intricacies of international trade. In such a situation revision of agricultural credit systems becomes a matter of urgent necessity, if rural industry is to maximize its opportunities.

In Australia, we have been fortunate in having for our guidance at this time a Rural Reconstruction Commission set up to inquire into all aspects of agriculture and to make recommendations thereon. The Fifth Report of the Commission keeps up the standard of its predecessors, and must be rated as one of the best comments on the subject prepared in this country.

In the introductory chapter the key to the whole message of the report is contained in the following sentence :

> " The lesson to be learned by farmers and suppliers of credit alike is that the productive capacity of any farm sets the limit of its capacity to meet credit requirements, notwithstanding its current market value or the value of any other assets used in operating it, and that abundant credit is not a remedy for a condition which is due to low prices, unsatisfactory farming, or an uneconomic farm."

This statement seems to summarize the very essence of the whole problem of rural credit. However, while thus emphasizing that there is a limit to the debt which any farm can safely carry, it is well to remember the converse, namely that credit which gives rise to productive assets and from which the added production more than covers debt charges is sound credit, and, generally speaking, farmers need more of it.

General Principles.

The first section of the report on capital in agriculture and the demand for credit sets out clearly many valuable and basic principles. After commenting on the necessity of capital for modern productive enterprise the Commission points out that capital for agriculture takes three forms :

(*a*) Basic capital for settlement and development, e.g. land and improvements the capital involved in the basic productive agent, the farm itself.
(*b*) Equipment capital—for agents of productive enterprise.
(*c*) Working capital—required to assist the actual processes of production.

The demand for such capital fluctuates, of course, but the greatest fluctuations occur with working capital requirements. Improvements to land, the demands of mechanization and the intensity of cultivation continue to increase the need for capital. Such assistance can only be secured by the farmer by way of loan or partnership, and in the former case he accepts a definite responsibility to make money payments available at regular intervals. These are the commitments which become " embarrassing in times of adversity ". Now such payments have to be made from

returns. It follows then that credit transactions need to be considered in relation to net returns from the productive enterprise. Also, net returns need to be related to capital value. The Commission proceeds to put the position thus: "Outstanding features of farming are the large number of farms which yield net returns, over a long period, of less than a fair commercial rate (say five per cent.) on the market value of the capital, and the variation in percentage returns from different farms."

It follows that the loan limits of farms are not always proportional to the market value of the capital employed in them. What are some of the factors adversely affecting the net profit rate in relation to invested capital?

Firstly, the Commission mentions the influence of non-commercial attractions on the market value of farming properties. Here, its comments have telling significance. In very many cases such factors as land hunger, desire for security, the attainment of social prestige, have driven farm prices up beyond the earning capacity valuation and have thus perpetuated conditions of economic instability. Other factors are uneconomic farm size and the use of excess capital. Net earnings also vary at various stages of farm development.

Both lenders and borrowers have failed to see the importance of farm returns in deciding borrowing capacity. Over-borrowing, and to some extent under-borrowing have been the result. This over-borrowing has caused many of the difficulties which are often used as a basis of representations for such claims as an all-round cheapening of interest rates and/or higher product prices. The Commission believes that a precise formula pinning down loan limits to a fixed proportion of capital value would be of little value. A figure must be arrived at bringing out clearly the relation of net returns on capital to the interest rate. Terms of repayment of principal amounts of loans must be related to the expected returns, so that, over the period of financial assistance, the farmer is not called upon to pay more than the balance left after covering his labour and interest commitments. Therefore it is the Commission's view that since farm returns do fluctuate, the obligations to meet regular instalments should be capable of temporary adjustments as required by the nature of the returns.

Thus far the Commission concerns itself primarily with what are actually the undesirable features of a rural credit system. The analysis makes clear the way to suggested improvements by sparing no single significant cause of existing faults.

The Commission then proceeds to a discussion of "Desirable Features of a Credit System". This section is probably the most important section of the whole report. The method of approach used is to consider each of the services of credit and then to examine the efficiency of the credit structure as a whole.

Elasticity of Credit.

Firstly, the Commission refers to the elasticity of credit, i.e., to the fluctuating demand for capital. There is an economic advantage for the farmer to have his changing demand for capital met by credit. He may be able to find the marginal outlay, but such a margin would lie inactive in good times. Subject to certain conditions, it is better for the marginal capital to be absorbed into the farm, and credit relied upon where necessary. But what of the elasticity of supply to meet the demands of a credit system? A wide diversity of demand may cause little change in the total demand for credit. But in Australia there are wide variations in seasonal and market conditions from year to year which often place a heavy strain on the existing sources of credit. The Commission's view is that these extra demands can be met only by a strong policy on the part of the central bank over the creation and distribution of credit plus sufficient confidence to create more if needed. Of course, the problem of the supply of rural credit is more than one of rural banking—it is related to general banking and other commercial activity.

Period of Loans.

Secondly, the Commission discusses the period of loans. This is all-important to the farmer. The capital provided must be available long enough to cover the

period of production for which it is required. Extra costs are involved in seeking a renewal of a loan. If the time for renewal coincides with a period when credit is scarce, such renewal may become difficult or will be associated with payment of a higher interest rate. If a loan is repayable on a fixed date, the farmer may be embarrassed if due date coincides with bad market conditions. Furthermore, many farmers receive credit from a number of lenders, each with his own conditions of repayment. Such duplication may present serious difficulties if conditions are bad.

Risk of Embarrassment.

The third desirable feature of a credit system, in the Commission's view, is the manner in which it serves the needs and comfort of the individual borrower. Such a system must try to minimize all risk of embarrassment. An example is given in the case of continuity of enterprise. A farmer may be preparing the soil for next season's crops before this season's crop has matured. If credit for cultivation of the new crops is not available before the debts in respect of the old one are discharged, there is a break in the continuity of production. Farmers frequently risk embarrassment by their choice of sources of credit. Some lenders will want the security of the most liquid resources. Others may not be able to stand the pressure of economic stress. The Commission believes that the farmer will suffer least embarrassment where

(*a*) he obtains all his credit from one lender, with the possible exception of the most short-term requirements ;

(*b*) the lender

(i) is financially strong,

(ii) considers the farmer's needs as to length of loans and the elasticity of the credit,

(iii) is able to lend considerably on fixed capital before lending on working capital,

(iv) is organized in such a way that representatives are near the farmer, are competent to assess his requirements in advance and are able to give quick decisions in an emergency.

The Price of Credit.

The fourth specific feature of a worthy credit structure considered by the Commission is the price of credit. Credit is a service and has its own price—interest—to compensate the owners of capital for foregoing liquidity. The actual price of credit is determined by a number of factors—the general conditions of supply and demand for money, the length of time for which liquidity is surrendered, the risks involved, and the costs of servicing the credit.

General conditions of supply and demand affect all loan transactions. This means that the price of agricultural credit is linked with the price of credit in the general market.

Part of the price of credit is influenced by the extent to which the lender sacrifices liquidity. The more of his resources he makes available and the longer the period of the loan, the more he will value the surrender of such liquidity. Accordingly, other things being equal, a private lender would require a higher rate of repayment for a longer than for a shorter period. But agriculture needs long-term credit, and so, the supply of credit has to be organized to shield the farmer from the individual's need for liquidity. This necessitates large intermediaries. Another method would be for the investor to be given bonds which he could sell on the open market if he wanted liquidity and still not affect total funds.

Risk.

Risk is a major factor in deciding the price of credit. The degree of such risk depends upon many factors. The supplier of credit protects himself against risk by adding something to his price. Two factors affect the degree of risk. These are :

(*a*) The risk in the enterprise and the capacity to assess it. This risk will vary from district to district and even from farm to farm. There are natural risks—rainfall, crop perishability, etc., and personal risks. The lender's confidence in his capacity to assess risk is all-important. The greater the degree of confidence, the less the need for a margin of error.

(*b*) The adequacy of the security. If a loan is made entirely on personal security, the lender assumes the risks associated with the personal qualities of the borrower. If the loan is made on the security of assets, risk will be less, and the more the assets cover the debt, the less the risk. This adequacy of cover in turn depends on the capacity to value the security, the margin between the loan and the value of the security, and the chances of a fall in the value of the security. This uncertainty as to valuation will affect the margin of security required, before it affects the price of credit which would be affected only when the margin of security is absent.

The loan transaction involves many services and their cost is influenced by proximity of the lender to the borrower, the scale of lending operations and the degree of efficiency attained. The handicap of remoteness can be lessened by a system of small banks, by local co-operative credit institutions or by large banks having branches. Efficient organization would involve the economical use of resources, a free and elastic movement of funds, and economical methods of assessing security and risk.

General Desirable Features.

Having focussed its attention on the individual matters of credit service, the Commission proceeds to define the desirable attributes of a credit service considered as a whole. The Commission suggests that a low-rate credit service supported by the government should be built into the credit system. To avoid adding to inefficiency, uneconomic farm size, excess debt commitments, inadequate plant, the new service should only be made available conditional on the efficiency of the farmer, and the taking of all means to promote economic efficiency. Furthermore, everything possible should be done to secure and maintain confidence between lenders and borrowers.

Summary of Commission's Views on Credit System Structure.

The Commission summarizes its views on what a rural credit system should be as follows :

(*a*) Such a system must be broad enough to include all types of rural enterprise.

(*b*) The supply of credit must be elastic enough to meet the fluctuating needs for capital.

(*c*) Loan conditions should be related to the changing circumstances of individuals.

(*d*) Risk of embarrassment to freedom of enterprise and to continuity of production should be kept to a minimum.

(*e*) The price of credit should be kept at such a level that agriculture will not be placed in a disadvantageous position compared with other industries.

(*f*) In a system which depends on private enterprise the competition of the organized credit market should be sufficient to avoid the development of monopolies in particular fields.

Existing Credit Sources.

Section III of the report gives a complete review of existing credit sources. The Commission wisely included private lenders, and traders and agents alongside the more obvious lending organizations. The Commission made it quite clear that private lending does in fact often involve serious difficulties, e.g. high initial costs, limited periods for loans, inflated land prices, individual opportunities for exploitation.

Its most obvious drawback is that private lending is rarely made available for working capital and hence the farmer usually has to seek a second source of credit for this purpose. The use of private credit would probably be less frequently availed of were the views of the Commission on the flexibility of repayment terms given effect. Most of these comments apply to a lesser degree to the other lending authorities—banks, insurance and trust companies, etc.

The Commission's views on traders and agents as suppliers of credit are worth noting. It considers that traders and agents, especially the smaller and less prudent ones, can have a disturbing effect on the credit structure if their actions are not considered with care. The same depressing effect on the farmer is produced by machinery and store credit. The hire purchase of machinery is not well controlled. Costs are high, losses through rash lending are frequent and hidden charges enter in. Moreover, the farmer's equity in the machinery is not well protected. As far as store credit is concerned, very often unnecessary risks are taken, prices have to be inflated generally to cover credit costs and losses, and, as the Commission points out, farmers tend to become " tied " to one store.

Referring to the trading banks, the most important source of agricultural credit in Australia, the Commission expressed the view that they do not give sufficient consideration to projects in stages of development, farmers with small capital, and tenant and share farmers. Trading banks could ease the burden of the small farmers by modifying the overdraft system. The Commission felt that three problems have to be overcome as far as trading banks are concerned :

(*a*) Over-lending in prosperous times.
(*b*) Pressure of withdrawals in bad times.
(*c*) Slowness sometimes in reaching decisions.

Speaking of government banks and agencies, the Commission pointed out that they have many and various forms but have suffered from a lack of planned development and co-ordination.

Views and Recommendations.

Having considered desirable and undesirable features of a credit system, and then proceeded to look at the existing conditions in Australia, the Commission had cleared the ground for its own suggestions. It made fourteen recommendations in all, on the following points :

1. That the Commonwealth and State Governments recognize the need for specialized rural credit services.
2. That certain general principles should be adopted, i.e. that a Rural Bank Service should be brought into being, that a Development and Reconstruction Service should be organized and administered by the Rural Bank, and that all existing government credit schemes should be transferred to the new authority.

   New South Wales already has a Rural Bank performing most, if not all, of these suggested functions.
3. That the details of the Commission's fourth report should be the basis for the establishment of the new credit service.
4. That Commonwealth and State Governments should co-operate by agreement and with appropriate legislation to recognize the sphere assigned to each, with the Commonwealth exercising supervision through the central bank and providing finance for approved credit intermediaries including the State Rural Banks.
5. That Commonwealth and State authorities should co-operate through the Loan Council, striving for uniform interest rates, and that they should constitute a consultative council. The Commonwealth Bank would provide a special Rural Credits Department to administer loans to the State banks, to act in an advisory capacity and to carry out research into rural credit.

6. That the Mortgage Bank Department of the Commonwealth Bank should not enter into competition with State rural credit authorities.
7. That the activities of the savings banks of Victoria and South Australia in fixing long-term rural mortgage lending should cease.
8. That existing State agricultural banks should be reorganized to conform with the recommendations of the Commission.
9. That where the Crown makes available Crown land, the practice of selling the land on terms, without regard to subsequent credit dealings by the settler, should be discontinued and either the land be sold for cash through the rural bank or the bank should administer the account so that the land should not subsequently be charged for debt without its knowledge and consent.
10. That governments should make all special purpose advances through the rural bank.
11. That the practice of making supplementary credit to necessitous farmers available from public funds should be discouraged and only be resorted to in extreme emergencies. In all other cases, the bank would exercise this function.
12. That all debt adjustment schemes should from now on be carried out by the bank.
13. That the operations of the English Agricultural Credits Act (1928) be investigated to see how far the introduction of its principles to Australia would help to encourage farmers to use direct bank credit for equipment and working capital to enable them to take advantage of cash terms offered by traders.
14. That in all agricultural trading transactions, whether of the nature of sale or of payment, it shall be a requirement of law that the cost of credit should be clearly and separately indicated.

One part of recommendation five on research is technically important to all the other clauses, namely that a public information service on credit facilities should be created. It seems evident that the entire success of any wide changes in the credit system will depend upon all parties—financial institutions, the farmers themselves, and even the general public—being well informed on the basic principles covered in the Commission's report.

A General Comment.

It is clear that the Commission has faced up to the most important aspects of the problem of agricultural credit. It has placed great emphasis on its central theme—that credit capacity has to be related to productive capacity—if serious difficulties are to be avoided. It is almost unique to see returns being given their due importance as the basis for deciding terms and conditions of loans. This approach links credit movements with all the personal, climatic and economic factors which do in fact decide the prosperity or otherwise of any country's agricultural system. Credit must be cheap and its distribution efficient.

But it is one thing to raise a problem, and another to solve it. This has been said of so many things that it has become a truism. However, in this case the gap between theory and practice has been bridged. The Commission has discussed principles and the need for adjustment to meet them, but, even more important, it has successfully provided for the practical application of those principles with a wealth of detail which completely covers the suggested objectives. Alterations in the existing machinery are provided for, and additions are suggested, the net outcome being that no major segment of the pattern of Australia's future rural credit system has been overlooked. Of course, much will depend on the degree of co-operation arrived at between Federal and State authorities.

The way to a rational credit structure for this country has now been clearly indicated. It is for all concerned to apply themselves to the details of working to the

suggested goals. It is therefore interesting as a final remark to observe that discussions are at present proceeding on ways and means to take the required steps for the implementation of the recommendations contained in all the reports of the Rural Reconstruction Commission, including that on rural credit.

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Plant Collections

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Russian Work on World Collections.

The work of the U.S.S.R. Institute of Plant Industry, led and inspired by N. I. Vavilov, provided a new basis for the survey and the utilization of the world's plant resources. Vavilov's phyto-geographical theory of the origin and evolution of cultivated plants, elaborated as a result of his exploration of the regions which he termed " centres of origin " of crop plants, led to the discovery of a vast number and variety of hitherto unknown forms, and gave a new meaning to the range of variation thus established.

Discovery and collection were followed by elaborate observation and description. For this purpose the collected material was grown in one or more localities, and was observed and classified for numerous morphological, physiological, agronomic, technological and other characteristics. This yielded results in two directions. For the systematist it provided a new type of evidence towards the establishment of phylogenetic relationships. To the plant breeder it gave a vast and systematically described range of building materials for constructive breeding.

Three Phases—Assembly' Classification and Maintenance.

The Russian work points to the two complementary phases in any survey of plant resources—assembly and classification. Each is incomplete without the other ; for both the systematist and the plant breeder require a complete and systematic array of the existing variation. To these two phases the plant breeder will add a third. His shifting aims and methods demand that collections be maintained alive. Material, once discarded or relegated to the herbarium, cannot be revived when new diseases, new breeding methods, new agricultural or industrial processes, or even his own achievements alter the breeder's aims and needs.

Surveys on these comprehensive lines have been attempted outside the Soviet Union only in few crops. Yet most plant breeding institutions assemble, and some maintain collections of crop plants which they obtain from various sources, and usually classify for relevant economic and other characteristics. Incomplete from the start, such collections as a rule dwindle rapidly, as lines of little economic interest for the time being or in the particular habitat are discarded and as others are lost through accident or neglect. Material and observations are frequently exchanged between stations, but this is a haphazard rather than a systematic process. No doubt, all too often one station discards material that others may urgently require.

The task of assembling, caring for and making available world collections is beyond the resources and the scope of the individual plant breeding or genetics

* From an address delivered to the annual meeting of the Australian Institute of Agricultural Science, Adelaide, August, 1946.

institution. It requires not only specialist knowledge and resources, but a specialist outlook. This is well demonstrated by the success of the team specially assembled to deal with the Empire potato collection.[1]

Importance of Survey.

That a comprehensive survey of the existing variation of cultivated plants is an important project can scarcely be questioned at a time when breeders of an increasing number of crops seem to approach the limit of economic advance. Its urgency is emphasized by the rapid spread of modern agricultural methods which threatens destruction to indigenous plant resources in the hitherto backward regions of the earth.

The need of preserving plant and animal stocks of economic or scientific importance was recently stressed by Landauer.[3]

Difficulties.

This brief survey is concerned with general objectives and with lines of approach. It does not attempt to deal with problems of technique. The difficulties involved in the maintenance of collections of cross-fertilized crops, for example, impose limitations on the scope of varietal collections of certain crop plants. This problem and others cannot be discussed here ; yet, it may be said that most of the difficulties which arise are familiar to, and are being tackled by breeders of various crops, and, further, that if comprehensive collections of some crop plants are unattainable there are many more which present few practical difficulties.

Many of the suggestions outlined below have been advanced in the course of the last twelve years by New Zealand and other delegates at a number of Empire and international scientific conferences. Some of the general ideas are supported in the report of a committee under the chairmanship of Lord Hankey,[2] and in the recommendations of the Imperial Agricultural Bureaux Conference, London, July, 1946.

Co-operative Central Collections.

It is obvious that no single institution or country could establish and maintain world collections of all cultivated plants. The proposals outlined in this paper are based on co-operation between a number of countries on a reciprocity basis. Each would undertake to look after " central collections " of one or more crops, and to make available material and information to all other participating countries and institutions. The main considerations governing the location of central collections would be suitability of ecological conditions and availability of facilities and trained personnel.

Complete Coverage.

The central collections should aim at assembling the most complete possible range of their respective crops. Sources of material would be :

Existing collections in various countries ;
Collecting expeditions where required ;
New varieties produced by breeders ;
Breeding lines with specific valuable characteristics.

One central collection responsible for the assembly and maintenance of any one crop is obviously preferable to small collections held by a number of co-operating stations. Hence, the ecological conditions should, if at all possible, facilitate the cultivation of the entire range. This, indeed, seems more relevant in the selection of a site than the relative importance of the crop in the particular locality.

Where the objective of one central collection is unattainable, division should take place along well-defined systematic lines.

As an alternative to central collections the Hankey report[2] proposes that participating plant breeding stations might undertake " to maintain small live

collections of types or kinds of specified crops with descriptions of them, and to send seed or specimens to other plant breeding stations when so requested" (p. 17). This procedure would render achievement of complete coverage unlikely; it provides little insurance against loss of lines; yet it may be the only practicable method in the case of certain cross-fertilized crop plants.

Classification' Observation and Description.

World collections of many crop plants are likely to consist of thousands of lines. The wheat collection of the U.S.S.R. Institute of Plant Industry numbered over 30,000 lines, and even that of *Triticum vulgare* contained many thousands. As a rule breeders attempt to obtain from collections either lines which may be directly useful, or crossing parents with distinctive characteristics. In either case a description of the lines contained in a collection would be of the greatest value to any user. Classification in fact should render a full use of the collection possible to any station, even those with relatively small resources, which would find it impossible to grow, test, and, therefore, to utilize hundreds or thousands of nondescript lines. Certain types of classification could be conducted at the central stations, e.g. systematic classification and some phenological observations, disease tests or technological evaluations.

Many observations which could not be made at the central station would be conducted by users of the collection. Correlation of observations would be rendered possible by the introduction of standard reference numbers. and by the maintenance of type specimens at the central stations. Such observations should be pooled, with the central station acting as a clearing house for information. Co-operation, if extended to classification, would thus prevent a good deal of duplication; it would also make available to all breeders the results of observations conducted under a variety of conditions.

Organization.

What kind of organization can one visualize as the framework for a co-operative survey of the world's plant resources?

Depending on the nature and number of crops to be covered, it could be confined to a few co-operating stations or countries, or extended to world-wide coverage. The larger the organization, however, the more likely it is to achieve complete coverage for its collections. Material held by members, as well as the scope of collecting expeditions, are likely to be in proportion to the number and the geographical range of participants.

An Empire organization is foreshadowed by the Empire potato collection and by the discussions and recommendations referred to above. Many crops of interest to Australia and New Zealand could be well covered on this basis, and New Zealand has offered, provided a general plan is agreed upon, to accommodate a world collection of wheat.

At the recent general meeting of UNESCO the maintenance of crop collections was placed on the list of projects in which the scientific branch of UNESCO may take an active part.

Whatever the basis and scope of the organization, it would require some central executive or secretariat whose functions would be the establishment of central and subsidiary collections, the organization of collecting expeditions, of joint publications, of exchanges with non-participating countries and related matters.

References.

1. Hawkes, J. G.: Potato Collecting in Mexico and South America, Imp. Bur.
2. Imperial Agricultural Bureaux: Report on by a Committee under the Chairmanship of the Rt. Hon. Lord Hankey. H.M. Stationery Office, 1943.
3. Landauer, W.: Sci., 101: 497-499, 1945.

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The Bacteriological Grading of Milk in New South Wales

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Introduction.

The standards at present in use for the grading of market milk in New South Wales are based on the original reductase ("old" methylene blue) test and the plate count. Both of these methods have been subject to severe criticism[1, 4] and are no longer used for the routine grading of milk in Great Britain. In the United States of America the regulations differ between States but, in general, the plate count is still widely used in conjunction with direct microscopic methods. As far as can be ascertained, only a few isolated factories in the United States have adopted the resazurin test for the routine grading of milk supplies. The position in regard to other States in Australia is not at present clear. Information is being sought concerning standards in use and also regarding investigations that may have been carried out. The "modified" methylene blue test is being used for the routine grading of supplies in the Brisbane City milk area, and Smythe[10] investigated the influence of storage time and temperature, such as are likely to be encountered in the Brisbane area, on the subsequent behaviour of milk in this test.

With the large amount of work published in Great Britain, the United States and Canada, the problem appears to be largely one of determining how far the findings overseas are applicable in the provision of standards for New South Wales.

The major stimulus to new work in the field of bacteriological grading came from G. S. Wilson, whose report to the Medical Research Council[14] gives the most comprehensive examination of the situation yet published. Wilson has provided ample data to show that the plate count and the "old" methylene blue test may often lead to erroneous conclusions, and that the modified method is not only more accurate but saves considerable time. Numerous investigators since 1935 have confirmed Wilson's findings, for example Nichols and Edwards.[9]

While the "modified" methylene blue test has met many of the requirements for routine grading, it has long been realized that it is by no means perfect since (i) it is not sufficiently rapid to detect poor quality milk before utilization; (ii) it does not detect physiologically abnormal milk from cows with diseased udders; (iii) the long incubation period at 37° C. means that the constitution of the flora is likely to undergo appreciable change. By about 1940 it was felt in some quarters in Britain that there had been a slow but steady downward trend in the quality of milk. The war gave a further stimulus in the search for a better and quicker means of grading milk to avoid loss arising from the contamination of a bulk supply by a relatively small amount of very bad milk.

Use of Resazurin.

Reinvestigations of the use of resazurin showed that this dye had certain advantages[2, 11]:

(i) Reduction of resazurin proceeded through several colour changes so that either the time to reach a certain colour standard or the colour after a certain interval of time could be utilized.
(ii) The dye was sensitive to physiologically abnormal milks.
(iii) The rapid reduction of the dye by very bad milks indicated the possibility of avoiding their admixture with the bulk supply.

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(iv) The shorter incubation period allowed less time for the flora to be changed by the conditions of the test.

The most comprehensive of the numerous investigations since 1940 was that of Davis, Newland and Knuckey,[2] from which it was concluded that all the dye tests (modified methylene blue and various procedures with resazurin) agreed well with one another and the " ten-minute " resazurin test with keeping quality, as estimated by " clot on boiling ". On the basis of these and other investigations,[3] a series of colour standards was adopted and incorporated in a disc for use with a modification of the Lovibond comparator. Further work by Davis and others[4] established that more accurate representation of the quality of the milk supply was obtained if the milk was held at air temperature before testing, the test time being adjusted, according to a more or less empirical scale, on the basis of the mean atmospheric shade temperature during the incubation period. This test is termed the " temperature compensated resazurin " test.

In Britain[6] the provisional adoption of (i) the rapid, or ten-minute, platform test, and (ii) the temperature compensated test, suggest the need for an investigation of their suitability for Australian conditions.

A recent assessment of the value of the resazurin tests has been made by Wilson and Anderson,[15] in which the rejection standards based on the ten-minute test are criticized as too lenient, and it is claimed that the modified methylene blue test remains the best index of keeping quality. It should be noted that Wilson and Anderson used the one-hour (routine) resazurin test—this work predating the adoption of the temperature-compensated test. On the other hand, S. B. Thomas with other workers[12] obtained good correlations between keeping quality and the temperature-compensated resazurin test. The highest correlation between the resazurin test and keeping quality ($r=0\cdot83$) was obtained for the higher atmospheric temperature range (10°-18·3° C.) at the upper end of which most New South Wales temperatures will fall during the greater part of the year.

Thomas has reported[13] a slight but significant improvement in milk quality since the commencement of the National Milk Testing and Advisory Scheme.

Recent private communications with Chalmers and with Higinbottom in the United Kingdom and with Stotlz in the United States, indicate that further critical studies are being carried out in the United Kingdom, but little or no work has been done in the subject in the United States since 1942. No work has yet been found relating to the use of the resazurin test for the routine grading of market milk in Australia. Hutton and McDonald[7] have, however, made a preliminary investigation of the use of resazurin for grading cheese milk in South Australia.

The Mechanism of the Dye Tests.

The mechanism of the methylene blue test and its relationship to the various reducing systems was extensively investigated by Wilson's team[14] but the same scale of investigation has not, as yet, been applied to resazurin.

The change—$\underset{\text{(blue)}}{\text{Resazurin}} \rightarrow \underset{\text{(pink)}}{\text{Resorufin}}$—is irreversible and proceeds, with increasing concentration of resorufin, through mauve, mauve-pink, pink-mauve to pink. The subsequent change—$\underset{\text{(pink)}}{\text{Resorufin}} \rightleftarrows \underset{\text{(white)}}{\text{Dihydroresorufin}}$—is, however, reversible. The end-point in methylene blue is dependent upon the potentiometric change and the system, being reversible, is influenced by aeration. High udder-cell samples may instantly partially reduce methylene blue but the dye is rapidly reoxidized by air. Resazurin, on the other hand, is readily reduced by such a system and this seems to depend on the total concentration of reducing systems in the milk, not necessarily on a change of redox-potential.[8] Frayer[5] investigated the dye's reduction in relation to Eh, pH and dissolved gases, and concluded that the resazurin

test was susceptible to a large number of reducing systems and therefore less safe as a routine test for use in dairy plants than methylene blue.

From the above, a very high order of correlation between resazurin and methylene blue tests could hardly be expected and, perhaps, too much emphasis has been placed on comparisons between the tests rather than evaluating each against a criterion, such as keeping quality.

The problem of assessing methods and standards for local production requires answers to the following questions :

(1) Which test gives the greatest amount of relevant information ?
(2) What is the value of the ten-minute resazurin test in excluding very bad milks from the bulk supply ?
(3) To what extent does the " old " methylene blue test, as used at present in this State, give a reliable indication of milk quality ?
(4) If it is to be replaced, would the " modified " methylene blue test, because of its somewhat simpler technique, or some form of resazurin test be the better substitute ?
(5) To what extent are the resazurin disc numbers, used as standards in the United Kingdom, likely to be applicable to New South Wales ?
(6) Is the temperature-compensated test of equal value here as in the United Kingdom ? Does the compensation scale require any modification ?

The present report represents only a preliminary investigation aimed to answer some of these questions ; it is hoped that their further solution will be the subject of a later communication.

Experimental.

The first series of investigations was commenced in the spring of 1946 when, at weekly intervals, milk from the same two farms (representing a " good " and " bad " producer) was sampled on arrival at the receiving platform, approximately five hours after production. Each sample was subjected to storage from noon on the day of production to 9 a.m. the following day at (*a*) 0° C., (*b*) 18° C., (*c*) atmospheric temperature in a ventilated shaded box. At the conclusion of the storage period, each sample was tested at 37° C. by (i) the old methylene blue, (ii) the modified methylene blue, (iii) the resazurin test.

Keeping quality at (i) atmospheric temperature, (ii) at 18° C. was estimated by taste, alcohol precipitation and change in pH. Keeping quality determinations represent approximations since they could be made only at 9 a.m., 1 p.m. and 5 p.m. daily.

In the second series, designed to gain further information concerning the behaviour of milks in the several dye tests, estimations were carried out by Mr. H. Laughton of the N.S.W. Milk Board, in co-operation with the authors. Nine lots of raw milk supplied to the Sydney depôt were tested by the three dye methods following three pre-testing storage conditions. These were performed in the early summer (November-December). The selection of producers was, of necessity, determined largely by convenience. They range, however, from " good " to " bad ", and it is not claimed that they are representative of suppliers generally.

Results.

Table I summarizes the findings for the first series of tests. The values presented are means of results for each producer for six successive weeks.

The relative merit of the two producers is shown by the values for keeping quality and is reflected in all three dye tests at each condition of storage.

Methylene Blue Tests. On no occasion in the six tests would the refrigerated sample of Producer A have been rejected, either according to the present New South Wales standard (5½ hours, old method), or on a standard based on the British Ministry

of Health (English summer, $4\frac{1}{2}$ hours, modified methylene blue). Such samples will have been exposed to air temperature—15° to 21° C.—for about five hours after production. On the other hand, Producer B fell below the local standard on one and below the calculated modified methylene blue standard on three of the six occasions. Storage for 21 hours at 18° C. obviously imposes a severe test and the relative superiority of Producer A is even more apparent. Air temperature storage (average 15·8° C.) shows a similar result intermediate between the other two. For longer reduction milks, as would be expected, the shortening of testing time due to modification of the procedure was most marked.

TABLE 1.

Results with Milk from Two Producers.

	Producer A. (Good.) 18·2° C.*			Producer B. (Bad.) 22·1° C. *		
	Treatment of Sample.			Treatment of Sample.		
	0° C.	18° C.	Ventilated Box. (Average 15·8° C.)	0° C.	18° C.	Ventilated Box. (Average 15·8° C.)
Keeping quality (hours from production)		45	64		26	39
Modified methylene blue ..	6·8	2·3	4·3	4·2	0·7	1·4
Old methylene blue	8·8	3·0	6·5	6·8	0·7	1·8
Time difference (old-modified)..	2·0	0·7	2·2	2·6	0	0·4
Resazurin, 10 min.	6·0	6·0	6·0	6·0	2·8	4·1
Resazurin, 1 hour	5·5	3·3	4·7	5·0	0·1	1·3
Resazurin, temperature compensated	—	6·0	6·0	—	1·7	2·6
Resazurin, time to Disc. 1 ..	5·6	2·0	2·5	2·7	0·5	1·4

All readings based on six occasions, duplicate values.

Methylene blue values and resazurin time to disc 1 recorded as hours.

Resazurin, ten-minute, one-hour and temperature-compensated tests expressed as disc number.

Time from production to sampling approximately five hours in all cases.

* Milk temperature on arrival.

Resazurin Tests. Besides recording disc values for the conventional periods used in the several resazurin tests, progressive data have also been obtained during the course of change from disc 6 to disc 0. Fig. 1 illustrates representative data.

There is a tendency for milk, especially with a short storage period to hold for some time at disc 6. In fact, under these conditions the length of the early phase does not differ much between milks although a marked difference develops later in the decolorization curves. This suggests that early resazurin readings (the ten-minute test) will not be discriminating for milk delivered to the depôt within a few hours of production. Pre-testing storage, however, would make the ten-minute test more exacting. Producer A remained at disc 6 on all occasions, but Producer B fell below disc 3 on four occasions. The one-hour and temperature-compensated tests distinguish effectively between the two milks after storage ; that the latter has some advantages over the former is suggested by the way it restores the value for Producer A to relative equality on different occasions. (Table 2.)

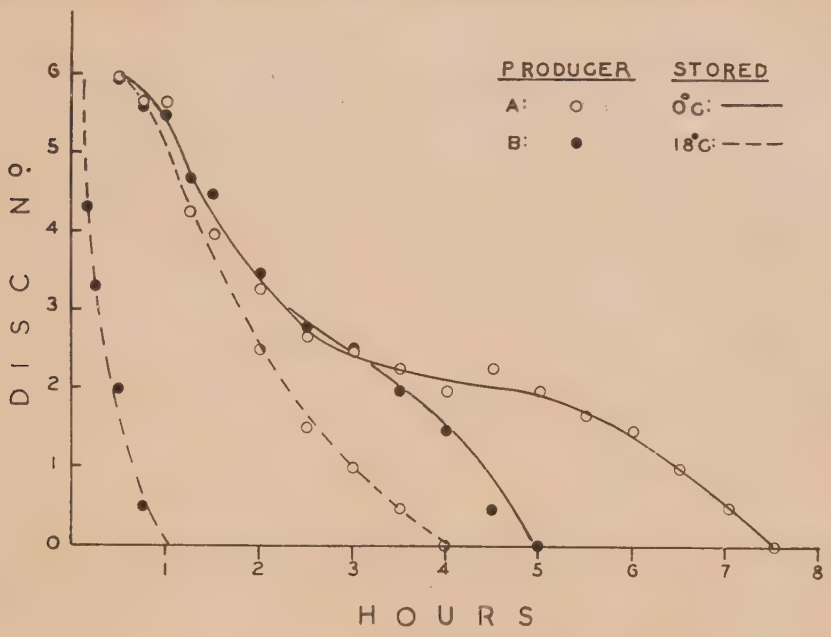

Figure 1.
Decrease in Resazurin Disc Number with Time for Two Producers.

The corresponding mean values for Producer B show that the temperature-compensated test maintains its sensitivity. Records of the six days separately show that Producer B would have had milk graded as unfit for salvage in four tests and as of doubtful keeping quality (Grade B) in ten tests out of the twelve sets of data available for 18° C. and air storage together. The one hour test after short storage period, represented by the refrigerated sample, showed very poor differentiation between the two producers.

TABLE 2.
Effect of Temperature Compensation on Resazurin Disc Readings.

Treatment.	Producer A. Week.							Producer B. Mean.
	1	2	3	4	5	6	Mean	
Refrigerated, 0° C., one-hour test ..	5·8	6·0	5·5	4·5	5·5	5·8	5·5	5·0
18° C., one-hour test	3·5	1·8	5·5	4·3	1·3	3·3	3·3	0·1
18° C., temperature-compensated test	6·0	6·0	6·0	6·0	6·0	6·0	6·0	1·7
In box,* one-hour test	6·0	4·8	5·5	5·5	1·3	5·3	4·7	1·3
In box,* temperature-compensated test	6·0	6·0	6·0	6·0	6·0	6·0	6·0	2·6

* Average temperature: 15·8° C.

It is convenient (but only as a first approximation) to treat the curve of colour change against time as linear to obtain an inverse measure of the rate of decolorization time required to reach disc 1. The results for the several samples are substantially in agreement with those obtained for methylene blue.

Significance of Milk Temperature. It will be seen from Table 1 that the milk from Producer A reached the depôt appreciably cooler than from B, and this would undoubtedly be a factor in its subsequent better performance. It will not serve to explain, however, the difference between the two producers. A difference due to this cause might be expected to be relatively more pronounced in a milk with a minimum of storage after receipt at the laboratory. In fact, the relative quality of milk A is more marked after laboratory storage when any earlier temperature effect will have been minimized. No doubt the lower temperature of milk A was one indication of this producer's better production methods. This superiority is also indicated by the succeeding modified methylene blue and one-hour resazurin data (means based on three occasions) for milks from the two producers having the same average milk temperature.

	Milk A.	Milk B.
Mean temperature	20° C.	20° C.
Modified methylene blue :		
(*a*) Refrigerated, 0° C.	6·7	4·7
(*b*) 18° C. storage	2·5	1·2
Resazurin, one-hour :		
(*a*) Refrigerated, 0° C.	5·6	5·7
(*b*) 18° C. storage	3·4	0·2

Further Factory Tests.

These results are summarized in Table 3 by applying more or less arbitrary standards that bear some relationship, however, to Australian or British practice. Each value states the proportion of milks that, out of three occasions, failed to reach the standard specified in respect of each test.

TABLE 3.
Samples Failing to Pass Provisional " Standards ".

Test.	Storage Treatment.	Producer No. 1	2	3	4	5	6	7	8	9	Total
Resazurin, ten minutes	Without incubation	0	0	0	0	0	0	0	0	0	0
	5 hrs. 18·3°–21·1° C.	0	1	0	0	1	0	0	1	0	3
	12 hrs. ,,	3	2	2	0	3	0	1	1	0	12
Resazurin, temperature-compensated	5 hrs. ,,	2	2	1	0	2	0	1	1	0	9
	12 hrs. ,,	2	2	2	1	3	2	1	2	0	15
Modified methylene blue	Without incubation	3	2	2	1	3	2	1	1	0	15
	5 hrs. 18·3°–21·1° C.										27
	12 hrs. ,,				All	failed					27
Old methylene blue ..	Without incubation	1	1	3	1	3	1	0	1	0	11
	5 hrs. 18·3°–21·1° C.	3	2	3	3	3	3	3	3	0	23
	12 hrs. ,,				All	failed					27

Provisional " Standards " :
Resazurin, ten-minutes : Disc 3½ or less.
Resazurin, temperature-compensated : Disc 3 or less.
Methylene blue, modified : Time for reduction less than 4½ hours.
Methylene blue, old : Time for reduction less than 5½ hours.

All milks can be taken as approximately five hours old at the time of sampling. The five-hour stored sample gives, therefore, some basis of comparison with the English accredited milk standard.

Discussion.

There is substantial agreement between the several dye tests examined in this preliminary investigation. The resazurin temperature-compensated test readily

distinguishes between the two producers in the first series, but the results suggest that the ten-minute test is generally unsuitable for milks received and tested within a few hours of production. This does not, of course, preclude its use for the rejection of extremely bad milks but it seems that in general some longer period needs to elapse between production and testing. This test might be better adapted to the examination of mixed night and morning milks.

The results reported in this preliminary investigation emphasize the importance, particularly under Australian conditions, of the time-temperature relationships of milk storage before testing. This conclusion is strengthened by consideration of Table 3, which makes it apparent that before a fair line of distinction can be drawn between the good and bad producer very much more information will be needed as to how milks react to these variables. There is surprisingly little information on this point available in the large body of overseas investigations and, in any case, Australian temperatures are likely to be outside the range usually investigated in cooler climates. Smythe[3] has already encountered the problem in connexion with the methylene blue test in Brisbane and has made an excellent contribution. In examining the time-temperature relationships, the present authors are extending Smythe's investigations over longer incubation times for methylene blue, and initiating a fairly detailed study of the resazurin test. It is hoped to be able to report on this further work in the near future, and that it might form a more rational basis for the determination of local milk standards. Information on the detail of the colour change involved in the resazurin test is also being obtained.

Summary.

The present article reviews recent overseas experience with the methylene blue and resazurin grading tests for milk and considers this information in the light of local needs.

Results of some preliminary investigations are reported. These emphasize the futility of attempting to apply British standards to Australian conditions without an adequate investigation of the influence of storage time and temperature on the dye reduction values.

A start has been made in obtaining such data, extending the work of Smythe in Queensland for the modified methylene blue and investigating the several resazurin tests.

Acknowledgements.

The authors wish to acknowledge the interest of the members and officers of the New South Wales Milk Board, and, in particular, the assistance rendered in the course of the investigations by Mr. H. Laughton, Field Officer of the Board. The N.S.W. Fresh Food and Ice Co. have offered every facility in the collection of samples and we are indebted to Miss M. Colbron of this School for considerable technical assistance.

References.

1. Barkworth, H., Irwin, J. O., and Mattick, A. T. R.: J. Dairy Res., 12: 265-314, 1941.
2. Davis, J. G., Newland, L. G., and Knuckey, P. B.: Dairy Industr., 8: 23, 71 and 115, 1943.
3. Davis, J. G., and Thomas, S. B.: Dairy Industr., 5: 244, 1940.
4. Davis, J. G.: Food Manuf., 17: 308–311 and 344–349, 1942.
5. Frayer, J. M.: Vermont Agric. Exp. St. Bull. 498, 1942. (Dairy Sci. Abstr. 6: 144, 1944.)
6. Great Britain, Ministry of Agric. and Fish.: Forms C. 158/TPY, 1942, and C. 150/TPY, 1943.
7. Hutton, E. M., and McDonald, V. R.: J. Dept. Agric. South Australia, 15: 361–365, 1941.
8. Johns, C. K., and Howson, R. K.: J. Milk Tech., 3: 320, 1940.
9. Nichols, A. A., and Edwards, S. J.: J. Dairy Res., 7: 258–270, 1936.
10. Smythe, V. R.: Qld. J. Agric. Sci., 2: 128–156, 1945.
11. Thomas, S. B.: Welsh J. Agric., 17: 117–130, 1943.
12. Thomas, S. B., *et al.*: Dairy Industr., 9: 634–39, 644, 699–701, 724; see also 867–70, 1944.
13. Thomas, S. B.: Dairy Industr., 12: 120–126, 1947.
14. Wilson, G. S., *et al.*: Med. Res. Council Spec. Rep. No. 206, 1935.
15. Wilson, G. S., and Anderson, E. B.: J. Dairy Res., 14: 21–37, 1945.

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Small-Scale Tests with D.D.T. and Benzene Hexachloride Incorporated in the Soil

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In a previous paper,[1] reference was made to tests with potted maize which were carried out in 1945 as a preliminary to field experiments in control of black beetle (*Heteronychus sanctæ-helenæ* Blanch). The information derived from the pot tests was not published in detail as it appeared to have no application outside the specific purpose for which the tests were undertaken.

However, it now appears that data from this small-scale work may have some bearing upon current problems of soil disinfestation in small areas. The following account of the results obtained may therefore interest those concerned with the control of soil-dwelling pests in horticultural practice.

The four tests described below were set out in the grounds of the insectary at the Botanic Gardens, Sydney.

The various insecticidal dusts used in the experiments were prepared by mixing kaolin with one or other of the following:

(*a*) A dust containing 10 per cent. D.D.T (=9·5 to 10 per cent. p, p-isomer) on pyrophyllite.

(*a*) A dust containing 14 per cent. benzene hexachloride (=1·07 per cent. γ isomer) on pyrophyllite.

Test No. 1.

This experiment was designed to discover whether germination of maize is adversely affected by certain dosages of D.D.T. or benzene hexachloride (666) in the soil.

Heavy reddish-brown loam from Glenfield was screened, thoroughly mixed and divided into three parts, each of which was impregnated with a different dust (Table 1, 2nd column). Dispersion of the dust through the soil was effected by placing each gallon of soil in a drum, stirring in ½ lb. of the appropriate dust and rotating until a uniform mixture was obtained.

Table 1.

Details of Soil Treatments, Test No. 1.

Treatment.	Dust Added to Each Gallon of Soil.	Dosage Rate of D.D.T. or 666 per Cubic Foot of Soil.
A	½ lb. of 6 per cent. D.D.T. dust ..	85·0 gm.
B	½ lb. of 6 per cent. 666 dust	85·0 gm.
C	½ lb. of pyrophyllite kaolin (50 : 50) ..	—

The treated soil was made up into twelve miniature plots arranged in four randomized blocks. The plots were prepared as follows:

Twelve rectangular holes (each $8\frac{1}{2} \times 5\frac{1}{2}$ inches in area and 6 inches deep) were dug in an area of firm ground, the distance between holes being 14 inches in one direction and 15 inches in the other. The holes which were of one-gallon capacity were filled with soil which had received one of the treatments A, B or C.

In each of the plots so formed were sown eleven seeds of Hickory King maize. Six of the plots (Blocks II and III) were prepared and planted on 21st September and the other six on 24th September.

Results.

The numbers of plants showing above ground in the various plots on 9th October are shown in Table 2.

TABLE 2.
Numbers of Plants Above Ground on 9th October.

	Block I	Block II	Block III	Block IV	Total.	Condition of Plants.
Treatment A (D.D.T.)	10	10	9	10	39	Normal.
Treatment B (666)	0	0	1	0	1	Abnormal.
Treatment C (control)	9	9	9	11	38	Normal.

An inspection of the plots on 16th October showed that :

(1) In treatments A and C, the 77 original plants referred to in Table 2 had made good growth in contrast to the single original plant in Treatment B, which had not increased in height.

(2) The plants in Treatment A appeared equal in health and vigour to those in the control series (Treatment C).

(3) Three more plants—one in each treatment—had appeared above ground since 9th October. In Treatment B the additional plant had the same abnormal structure as the first plant. In Treatments A and C the new plants were small, weak and apparently suffering from seedling blight ; both died within a few days and will be omitted from further consideration.

When the observations of 16th October had been completed the four plots of Treatment B were broken up to permit examination of the seeds which had failed to develop normally. It was found that 42 of the 44 seeds planted had either failed to germinate at all or had died in the early stages of germination. The two plants which had reached the surface were very abnormal in structure, with thick, blunt shoots.

The eight plots comprised in Treatments A and C were not broken up for examination ; instead they were incorporated in a new experiment (see Test No. 2).

Conclusion. In this experiment it was demonstrated that D.D.T. added to soil at the rate of 3 oz. per cubic foot had no ill-effect upon germinating maize, while benzene hexachloride, applied at the same rate, prevented normal germination.

Test No. 2.

In this experiment the remaining material of the first test was used to investigate the value of D.D.T.-treated soil in protecting maize from attack by the adults of " black beetle " (*Heteronychus sanctæ-helenæ*).

Test No. 1 had been laid out in a block of ground in which sampling had provided no evidence of beetle infestation at the start of the test. During the currency of Test No. 1 only one beetle was noticed in the experimental area and no evidence of beetle damage could be found in any plot. As natural infestation appeared to be negligible in the plots of Test No. 1, it became necessary, for purposes of Test No. 2, to arrange for an artificial infestation.

This was done by transferring the required plots from the open ground into large pots which could be fitted with gauze covers to confine the beetles. Details are as follows :

The four plots of Treatment A and the four plots of Treatment C were removed in their entirety from the ground. This presented no difficulty because the small, rectangular plots of Glenfield soil had consolidated into firm, brick-shaped masses readily separable from the Sydney soil around them. Each plot, complete with plants, was then set into untreated soil in a 12 in. pot, its surface being level with the rim of the pot. This transfer of the miniature plots was carried out on 16th October.

On 19th October 20 beetles were placed in each of the eight pots, which were then fitted with wire gauze covers about a foot high and approx. 13 in. in diameter.

Results.

At intervals during the period 19th October-29th November records were made of (1) the condition of plants, and (2) the condition of any beetles visible at the soil surface. A summary of these observations is given below.

Condition of Plants.

In the four pots of the control series the characteristic ill effects of black beetle upon the plants appeared early and continued to increase throughout the term of the experiment.

By the 22nd day 31 per cent. of the plants had been killed and a further 42 per cent. were showing various degrees of damage. At the end of the test (20th November) 45 per cent. of the plants were dead and a further 18 per cent. were injured beyond recovery. At that date only 14 of the original 38 plants were still upright and green.

D.D.T.-treated Pots.

During the entire period of the test none of the characteristic symptoms of black beetle attack were observed in the four pots of the D.D.T. series.

In three of the D.D.T.-treated pots an occasional leaf showed perforations about 6 to 10 inches above the ground, caused by beetles. The same ragging of leaf tissue was noticed in one of the control pots. This very minor and aberrant feeding activity (which is unknown under field conditions) may have been prompted by the beetles' confinement under the gauze covers. In every instance the interference with the plant was so slight that it can be disregarded.

Condition of the Beetles.

To avoid any digging up of plants, all estimation of the beetles' condition was based on the numbers of dead, sick and healthy beetles which could be found without disturbing the soil. The findings may be summarized as follows :

(*a*) Dead beetles were fairly numerous in the D.D.T. pots but were scarce in the control series. The totals for the individual pots treated with D.D.T. were 6, 11, 13, 8 respectively, while in the control pots there were 0, 1, 2 4, respectively.

(*b*) Sick beetles : During the first 10 days of the experiment beetles showing the twitchings typical of D.D.T. paralysis were found in three pots of the D.D.T. series.

(*c*) Healthy beetles : On 10th and 20th November healthy beetles were observed in three pots of the control series, attacking plants at or just below soil level ; as many as 7 beetles were counted in one pot (10th November). No healthy beetles were ever seen at the soil surface in any D.D.T.-treated pot. In both sets of pots healthy beetles were occasionally found climbing on the inside of the gauze covers.

Conclusion. Under the conditions of this test, D.D.T. added to soil at the rate of 3 oz. per cubic foot enabled young maize plants to be grown without important damage from black beetle. During the 32 days' duration of the test the treatment also killed a substantial proportion of the beetles.

Test No. 3.

This was designed to find a concentration of benzene hexachloride in the soil which would protect maize from black beetle attack without inflicting chemical injury upon the plants.

The experiment provided for a trial of benzene hexachloride at two different concentrations against (i) D.D.T. and (ii) a control (inert dust only).

Preparation.

Well-mixed soil exactly similar to that used in Test No. 1 was divided into four portions, each of which was impregnated with a different dust.

In dispersing the dust through the soil the following routine was adopted :

Half a pound of dust was placed in a drum and soil was added until the gallon mark in the drum was reached. The drum was then rotated until a uniform mixture was obtained.

TABLE 3.
Details of Soil Treatments, Test No. 3.

Treatment.	Dust.	Concentration of D.D.T. or 666 in the Final Soil Mixture.
A	0·5 per cent. 666 dust	7·1 gm. 666/cub. ft.
B	2·0 per cent. 666 dust	28·3 gm. 666/cub. ft.
C	6·0 per cent. D.D.T. dust	85·0 gm. D.D.T./cub. ft.
D	Pyrophyllite kaolin 50 : 50	—

On 22nd October two flower pots were filled with the soil from each treatment and nine grains of maize were then planted in each pot. On the same day seven beetles were placed in each pot and wire gauze covers were fitted to enclose the beetles.

Results.

By the seventh day a satisfactory number of plants had appeared above ground in all treatments except B (666 at heavier rate). In the latter treatment only four plants out of eighteen were showing, compared with thirteen to fifteen in the other treatments. By the eleventh day this disparity was considerably reduced, the totals for treatments being : A, 18 ; B, 14 ; C, 17 ; D, 15.

The dwarfing effect of benzene hexachloride was apparent as early as seven days after sowing. With Treatments C and D the young plants were notably taller than those in B, which in turn were taller than those in Treatment A.

Apart from the dwarfing mentioned above, the following abnormalities were seen in the plants of Treatments A and B :

(i) Twisted growth of leaf lamina.
(ii) Markedly swollen appearance of roots.
(iii) Discoloration of leaf tissue (unusually dark green with a purplish cast).

By the end of the experiment (22nd November) the great majority of plants in Treatment D measured between 12 and 16 inches ; in Treatment C the growth was even better. In Treatment A, however, the average height of plants was only 4·3 inches (tallest plant 6 inches). Growth was even poorer in Treatment B, where the mean height of nine plants was only 1·65 inches (tallest plant $3\frac{1}{2}$ inches).

After the plants had been measured on 22nd November they were freed from soil and then weighed (Table 4).

Examination of the plants at 22nd November revealed no evidence of beetle damage in Treatments A, B and C. In Treatment D, however, a majority of the plants had been attacked, most of the damage was light, and none was severe.

As noted above, the plants of Treatment D (control) were inferior in mean height and weight to the plants in Treatment C (D.D.T.). No doubt this relative inferiority of the controls was largely an effect of beetle injury.

TABLE 4.

Mean Weight (gm.) of Plants in Each Pot at 22nd November, 1945.

	Block I.	Block II.	Mean.
Treatment A	2·1	1·8	1·9 (18)
Treatment B	1·5	1·6	1·6 (16)
Treatment C	8·0	10·8	9·5 (17)
Treatment D	6·1	5·8	6·0 (14)

Figures in brackets represent the number of plants on which the mean is based.

Eggs and young larvæ of black beetle were found in the soil in both pots of Treatment D, but nowhere else in the experiment.

Conclusion. Benzene hexachloride in soil at $\frac{1}{4}$ and 1 ounce per cubic foot of soil mixture protected young maize from beetle attack but caused excessively severe injury to the plants. D.D.T. at 3 ounces per cubic foot protected the plants and inflicted no apparent chemical injury.

Test No. 4.

The aim of this test was to study the growth of maize in soil containing benzene hexachloride at lower concentrations than those used in Test No. 3.

Well-mixed Glenfield soil, as used in the preceding tests, was divided into three portions. Two of these were impregnated with dusts A and B respectively, using the technique adopted in Test No. 1. The third portion of soil received no admixture of dust, but was kept as a control.*

TABLE 5.

Details of Soil Treatments, Test No. 4.

Treatment.	Dust Added to each Gallon of Soil.	Dosage Rate/ Cubic Feet of Soil.
A	$\frac{1}{2}$ lb. of 0·27 per cent. 666 dust ..	3·8 gm.
B	$\frac{1}{2}$ lb. of 0·11 per cent. 666 dust ..	1·6 gm.
C	Nil.	—

Three six-inch flower pots were filled with soil from each treatment and seven seeds of maize were then planted in every pot. A trench six inches deep was dug in the ground to accommodate the nine pots which were arranged in three randomized blocks.

Soil treatment and planting of maize were both carried out on 24th October, 1945.

* In this control, though no dust was added, the soil was rotated in a drum so that it had the same mechanical treatment as was given to A and B.

Results.

Germination in all pots was good, for 61 plants developed from the 63 seeds planted.

As the experiment proceeded it became clear that the treatments were affecting the plants, for the rate of growth was normal in the controls, subnormal in Treatment B and very slow in Treatment A.

On 26th November (33 days after sowing) the plants were measured, shaken free of soil, and weighed. The results are given in Table 6.

TABLE 6.

Mean Weight and Height of the Plants in each Plot 33 Days after Planting.

Treatment.	Mean Weight (gm.).			Mean Height (ins.).		
	Block I.	Block II.	Block III.	Block I.	Block II.	Block III.
A	3·2	3·2	6·6	5·3	5·7	No record
B	11·5	10·3*	13·1	12·4	12·0*	13·4
C	16·5*	15·4	18·3	16·1*	14·8	16·0

* Mean for six plants ; all other figures are means of seven plants.

Apart from their noticeably smaller size, the plants of Treatment B were no worse than the controls. In Treatment A, however, the plants were greatly stunted and showed a slight degree of malformation ; the roots were unduly short and swollen and there were traces of distortion in the leaf structure. However, these abnormalities were far less obvious than those observed in Test No. 3 (Treatments A and B).

Conclusion. The growth of young maize in pots was adversely affected by benzene hexachloride added to soil at the rate of 0.05 oz. to each cubic foot. Under the same conditions benzene hexachloride at approximately 2½ times the above dosage caused severe dwarfing of maize as well as slight malformation.

Possible Applications.

Soil mixed with suitable quantities of D.D.T. or benzene hexachloride should prove useful in protecting horticultural plants from soil pests. Treated soil could be used to grow crops in green-houses ; it might be used in seed beds, in the growing of potted plants, and possibly as casing soil in mushroom culture.

Rows of nursery stock could be planted out in trenches filled with treated soil. In starting plantations, vineyards, etc., the young plants would be placed in their planting-holes, which would then be filled with soil suitably mixed with insecticidal dust.

Reference.

1. Wallace, C. R. : J. Inst. Agric. Sci., 12 : 96–102, 1946.

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Climatic Mapping

A REPORT BY THE AUSTRALIAN INSTITUTE OF AGRICULTURAL SCIENCE.*

The views expressed in this report are grouped under :
(*a*) Basic requirements of maps for agricultural research workers.
(*b*) Comments on the specific type of maps proposed by the Bureau.
(*c*) Additional proposals in regard to mapping.
(*d*) Publication of climatological data.

Basic Requirements of Maps.

For climatic maps to be of the greatest value to the wide range of agricultural research workers, the type of information mapped and the interval for which it is mapped are the two most basic considerations.

Maps of climatic elements or components such as temperature, rainfall, etc., are very much to be preferred to those based on formulæ or indices, such as that of Köppen. The Climatological Atlas, of course, gives several of these components and suggestions are made later in this report for the mapping of additional elements of climate.

Secondly, it is considered that monthly maps are generally preferable to two-monthly, seasonal or annual maps. Nevertheless for northern Australia it has been urged that two-monthly maps display climatic information advantageously. For other parts of the continent, very close examination would be required before it would be certain that two-monthly maps would be of value. Any large-area seasonal map is open to the objection that the seasonal limits to be mapped must be decided arbitrarily and, therefore, over more than limited areas may not coincide with the limits of plant growth or the climatic aspects of some other problem which is being investigated.

Comments on Maps Proposed by Bureau.

(1) *Climatic Types on the Köppen System.*

Maps of this type are of very limited value to agricultural scientists, largely because they are too broad and fail to take adequate account of the very different requirements of different crops. The publication of such maps should not take precedence over that of more useful ones, displaying specific climatic data.

(2) *P/E Ratio (Annual and Seasonal).*

Maps on a monthly basis are preferred to seasonal or annual maps, although a two-monthly grouping has been found useful in studies undertaken in Queensland.

Use of the P/E rather than the P/s.d. ratio as the basis for mapping has many advantages, but it cannot be fully applied until evaporation data is more widely available. It is recommended that more standard evaporimeters be installed as soon as possible.

Maps showing the difference between mean monthly P/E values for different seasons of the year have been found useful for some purposes, e.g. for the delimitation of certain vegetation types. Further study is required before their usefulness can be fully assessed.

(3) *Rainfall (Seasonal Averages).*

These maps have a use for broad comparisons between areas, but are subject to the general objections to " seasonal " mapping mentioned above. A two-monthly

* At the request of the Director of the Commonwealth Meteorological Bureau, the Institute undertook to comment on the value to agricultural scientists of a proposed series of climatic maps. Council invited comments from Branches and these were co-ordinated and expanded into this report presented in May, 1947.

basis was considered necessary for the adequate representation of rainfall incidence in northern Australia. A monthly basis is considered optimum.

(4) *Rainfall Variability* (*Annual and Seasonal*).

Annual or seasonal rainfall variability maps were generally considered to be of little use, and might possibly be misleading. A monthly mapping would be preferable, but for most purposes some method of representing the reliability of the effective rainfall (as discussed under (8) below) would be much more useful.

(5) *Rainfall Intensity* (*Maximum Recorded in 24, 48 and 72 Hours*).

Maps of rainfall intensity prepared on this basis would be of value. Such maps would be of much more value if they were prepared to show maximum expectations once in periods of (say) 5, 10, 20 and 40 years. For the use of soil conservationists and hydrologists especially it will be essential to have information on rainfall intensity over periods as short as one hour and less. It is recommended that many more pluviographs be installed to obtain this data.

(6) *Rainfall Frequency* (Frequencies of days of specified amounts: 1-25, 26-50, 51-100 and over 100 points in 24 hours).

It was generally agreed that rainfall frequency maps of this type would be useful, but for adequate representation of the rainfall in northern Australia the upper limits should be extended to include falls of 101-200, 201-400, 401-800 and over 800 points in 24 hours. A map showing the total annual amount of rain falling as 100 points or more in 24 hours would supplement other maps of rainfall intensity and frequency.

(7) *Drought Frequency.*

The drought frequency maps already made for New South Wales were generally thought to be very useful, and should be extended to the rest of the continent. On the other hand, one suggestion made was that the duration of dry weather is the most important consideration, and that this might be expressed as the number of consecutive days in each two-monthly period on which there is less than 25, less than 50, less than 100 and less than 200 points of rain. This is an absolute measure of drought, as distinct from the relative measure proposed by the Bureau.

(8) *Influential Rainfall.*

Maps of influential rainfall were included among the tentative suggestions made by the Meteorological Bureau, but without full details. In reports prepared by the Bureau in connexion with soldier settlement schemes, the criterion of effective rainfall has been based on Prescott's revised formula (P/E $0 \cdot 7 = 0 \cdot 54$).

The comments received from branches of the Institute on this proposal indicate both the great importance attached by agricultural scientists to mapping of influential rainfall and the difficulty of reaching agreement on the most useful form of such maps.

While one suggestion was for maps of effective rainfall on a uniform basis (e.g. Prescott's revised formula), it was generally felt that no universal definition of effective rainfall was possible. As an alternative, support was given to a proposal that monthly maps be prepared showing lines of equal P/s.d. average, probably at the 1, 2, 5, 10 and 20 levels. These maps would give the basic information for use in many agricultural problems.

At the same time, the need was recognized for some form of mapping which would indicate the probability of a particular level of effective rainfall being reached in any month. This could be done, in part, by preparing monthly maps showing the effective rainfall that can be expected in 50 per cent. of years, i.e. lines of equal P/s.d. median at the 1, 2, 5, 10 and 20 levels. Similar maps might also be prepared showing the effective rainfall to be expected in 66, 70 or 75 per cent. of the years,

these being of particular value in assessing the reliability of a region for agricultural production.

A further suggested development is the preparation of maps showing the expected growth season, i.e. maps showing the number of consecutive months in which the effective rainfall might be expected to exceed a given value. Such maps have been prepared for limited regions, using as the base level for " wet " months values of

(1) P (mm.)=T° C.+10
(2) P=(0·2 E (summer))
(0·3 E (winter)).

(9) *Wind Roses* (*showing an Analysis both for Direction and certain Ranges of Speed*).

The opinion was expressed that maps giving wind roses would be of practical values in assessing the usefulness of windmills and in planning paddocks and windbreaks.

The proposed maps showing analysis of wind direction and speeds should be accompanied by maps showing the frequency of occurrence of heavy gusts, e.g. maps might be constructed with isolines showing the frequency with which wind velocities may be expected to exceed, say, gale, or strong gale force, in each month.

Additional Proposals for Maps.

Some of these have already been discussed under items (2), (6), (7) and (8) in the previous section, but the following additional proposals could not readily be included elsewhere :

(1) As a basis for future maps, it was recommended that further data be obtained on (*a*) hail incidence, (*b*) hours of sunlight, (*c*) average length of frost-free season, and (*d*) range of dates of first and last frost.

(2) As a means of permitting a quick visual appreciation of climate at a number of localities, and shifts in climate between them, it was suggested that maps be prepared showing in insets the main climatic data for selected sites. Such sites would be well distributed through the country, and the insets might show in graphical form :
   (*a*) Seasonal distribution of mean monthly rainfall (or P/s.d.).
   (*b*) Seasonal distribution of mean monthly maximum temperature.
   (*c*) Seasonal distribution of mean monthly minimum temperature.
   (*d*) Median dates of first and last frosts.

(3) There is a distinct need for the publication of a periodical bibliography on Australian climatic maps, which are scattered over a great variety of publications. The suggestion is also made that selected existing maps on the climatological aspects of agricultural problems may be well worth republishing, thus bringing the more important ones together under one cover.

Publication of Climatological Data.

Very strong emphasis is placed on the need for having readily available, in tabulated form, the climatic data used in the preparation of the several maps. Maps are useful as a first approach in correlating climatic factors with agricultural phenomena, but for more exact work it is usually essential to refer to the precise data on which such maps are based. It is also stressed that the publication of basic data for monthly precipitation, evaporation or saturation deficiency, maximum and minimum temperature, hours of sunshine, and incidence of frosts is preferred to the publication of relatively uninformative maps. Finally, it is pointed out that the monthly interval is the best for general use though for detailed work it is frequently necessary to get down to days or periods of days. For this reason it is always advantageous to have the basic data for the factors concerned readily available. Expressions and maps can be built up from these as required.

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Technical Notes

POPULATIONS OF *THRIPS TABACI* LIND. ON BEAN VARIETIES.

The onion thrips *Thrips tabaci* Lind was prevalent on flowers and vegetables in southern Tasmania during the summer of 1946-47. During February, 1947, severe thrips damage was observed on certain bean varieties in a small-scale varietal trial at the Horticultural Experiment Station, New Town.

The infested plot consisted of fifteen different varieties of beans growing in single rows, each variety being replicated two or three times. Because of the varying thrips damage that could be seen on the different varieties, counts were made of the numbers of thrips present on the plants.

Ten plants were selected at random along each row. Three leaves were picked from each of the selected plants—from the top, middle and bottom of each plant. The numbers of nymphal thrips were counted under a binocular dissecting microscope. Nymphal thrips only were counted, since it was considered that they represented the best index of the breeding occurring on each variety.

Results.

The numbers of nymphal thrips on each variety are shown in Table 1. The varieties are listed alphabetically and not in the order of occurrence in the field.

TABLE 1.

Counts of Thrips on Fifteen Bean Varieties.

Variety.	Numbers of Nymphal Thrips.			
	Mean Number/Leaf (av. of 10 leaves).			Mean Number per Leaf.
	Top Leaf.	Middle Leaf.	Bottom Leaf.	
Black Valentine	10·5	7·7	9·0	9·1
Brown Beauty	10·0	7·6	6·2	7·9
Davis White Wax	7·9	7·2	11·1	8·7
Florida Belle	10·2	9·4	9·6	9·7
Hawkesbury Wonder	70·8	52·4	61·5	61·6
Medal	10·1	12·4	11·6	11·4
New Discovery	2·0	2·4	1·5	2·0
Norwegian Brown	14·1	10·3	10·0	11·5
Refugee	3·8	5·9	5·6	5·1
Staley's Surprise	16·8	17·6	12·3	15·6
Stringless Green Pod	13·7	17·8	20·9	17·5
Surecrop Wax	13·1	10·1	12·2	11·8
Tender Green	6·7	9·2	7·2	7·7
Tweed Wonder	13·7	10·1	14·3	12·7
Wellington Wonder	8·7	6·5	6·0	7·1

There is no indication in these figures that the thrips populations were confined to any particular zone of the plant.

Marked differences in the thrips populations on the various varieties can be seen in Table 1. On the varieties New Discovery and Refugee the populations averaged only 2·0 and 5·1 thrips per leaf respectively.

The twelve varieties—Tender Green, Wellington Wonder, Brown Beauty, Davis White Wax, Black Valentine, Florida Belle, Norwegian Brown, Surecrop

Wax, Medal, Stringless Green Pod, Tweed Wonder and Staley's Surprise—were found to carry populations ranging from 7·1 to 17·5 thrips per leaf. On the variety Hawkesbury Wonder, however, the thrips population was 61·6 per leaf.

Analysis of the data, after applying a logarithmic transformation, revealed that the population on New Discovery was significantly less than that on any other variety, and the population on Hawkesbury Wonder was greater than that on all other varieties.

These figures confirmed the obvious fact that the Hawkesbury Wonder plants were heavily infested with *T. tabaci*, since the plants of this variety had a general chlorotic appearance, enabling them to be distinguished from the rest of the plot.

Hawkesbury Wonder plants in another small varietal trial at Margate, about 20 miles from Hobart, were also found to be much more heavily infested by *T. tabaci* than other varieties in the same plot.

Discussion.

Plant resistance to insects may be due to a number of characters, physical, chemical, or physiological. The character of hairiness is one that has been shown important in determining the resistance of many plants to insect attack. McKinney[4] suggested that the recurved spines on string bean leaves limited the populations of *T. tabaci* on these plants. The potato leafhopper *Empoasca fabae* (Harris) was shown by Hollowell *et al.*[1] to be less troublesome on hairy strains of red clover. Similarly in South Africa, Worrall[5] found that the hairy American upland cotton was more resistant to the jassid *Chlorita fascialis* Jacobi than were the glabrous Egyptian varieties.

Of the bean varieties examined in obtaining the figures shown in Table 1, however, the leaves of the Hawkesbury Wonder plants were more hairy than those of other varieties. It was apparent, therefore, that hairiness of the leaves did not protect these plants from infestation by *T. tabaci*. On the contrary, the hairs on the leaves of the Hawkesbury Wonder plants appeared to facilitate the breeding of the thrips by creating a favourable microclimate for the insects and by protecting the nymphs from attack by larger natural enemies.

In this respect, the position appeared analogous to that reported by Jones *et al.*[2, 3] in onions where the populations of *T. tabaci* were found to be greatest on varieties having the leaf blades closely appressed and so protecting the thrips from enemies and adverse weather conditions.

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References.

1. Hollowell, E. A., Monteith, J., and Flint, W. P.: Phytopath., 17: 399–404, 1927.
2. Jones, H. A., Bailey, S. F., and Emsweller, S. L.: Hilgardia, 8 (7): 215–232, 1934.
3. ——————————: J. Econ. Ent., 28 (4): 678-680, 1935.
4. McKinney, K. B.: J. Econ. Ent., 31 (5): 630–631, 1938.
5. Worrall, L.: Union S. Africa, J. Dept. Agric., 7: 225–228, 1923.

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THE VALUE OF REFERENCE SPRAY SOLUTIONS IN INVESTIGATIONS WITH WEEDKILLERS.

In a spray trial carried out on skeleton weed (*Chondrilla juncea*) at the Dickson Experiment Station, A.C.T., a number of substances reported to be inhibitory or poisonous to plants or enzyme systems, but hitherto not tested as weedkillers, were used as sprays. These were sodium azide,[5] iodoacetic acid,[5] hydroxylamine

hydrochloride,[4, 5] m- and p-phenylene diamine.[3] The first three substances were used at 5 per cent. concentration, the others at 3 per cent. Arsenic pentoxide, at 5 per cent. concentration, was also included to provide for comparison with previous work.

Apart from a slight wind, the spray solutions were applied on the 2nd November under almost ideal conditions. The plants, selected for uniformity, were beginning to develop an aerial stem and had no senescent leaves. No rain fell for six days after the application of the spray.

The results observed six weeks after the application of the sprays were disappointing. In most instances only the leaves were killed, though of the ten plants treated with iodoacetic acid three were killed to a depth of 2 to $3\frac{1}{2}$ inches. In two of the plants treated with the arsenic pentoxide, only the leaves were killed; the remaining eight were killed to a mean depth of less than 3 inches.

In all other trials on skeleton weed, arsenic pentoxide has given good results. In one trial on wet soil, plants were killed with 7·5 per cent. arsenic pentoxide to a depth exceeding 12 inches.[1] In another trial on dry soil, plants in a comparable state of development were killed with 7·5 per cent. pentoxide to a depth of more than 23 inches.[2] In other, unpublished investigations arsenic pentoxide solutions at concentrations of 3 per cent. or more have given good results in wet or dry soil. Furthermore, in a trial at the Dickson Station on the 10th November, 1946, where 5 per cent. pentoxide was used, ten plants were killed to a mean depth of 14 inches within eighteen days even though rain fell within three days of application. In this experiment the plot was about 400 yards distant from that used on the 2nd November, 1946. In both experiments at the Dickson Station conditions for spraying were similar, with the exception that in the experiment of the 10th November the soil was moister.

On the basis of results obtained in the experiment of the 2nd November, the non-arsenical substances would have been considered of no value for the eradication of skeleton weed. However, in view of the poor results obtained with arsenic pentoxide, the other results are of uncertain value. Apparently, in this experiment, downward translocation was very poor. Why this experiment failed, and the experiment of the 10th November was successful, cannot at present be explained; a difference in water content of the soil cannot be responsible, because it has been shown that moist soil is not necessary for the downward translocation of arsenic pentoxide.

The results described here show the value of including one or more spray solutions of known efficacy in experiments relating to the downward translocation of poisons. If poor results are obtained with the reference solution or solutions, the results obtained with the other spray solutions should not be regarded as final.

Further experiments are in progress with the substances mentioned above.

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References.

1. Greenham, C. G., and Wilkinson, T.: J. Coun. Sci. Ind. Res. (Aust.), 15: 154–161, 1942.
2. Greenham, C. G.: *Ibid.*, 19: 341–346, 1946.
3. Jones, R. F.: Nature, 154: 828, 1944.
4. Lemoigne, M., *et al.* Bull. Soc. Chim. biol., 20: 441–448, 1938, abs. Brit. Chem. and Physiol. Abs. Aiii, 704, 1938.
5. Sumner, J. B., and Somers, G. F.: Chemistry and Methods of Enzymes. Academic Press, Inc., New York, 1943.

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The Australian Institute of Agricultural Science

MEETING OF COUNCIL.

The Council met at Science House, Sydney, on 17th June, 1947.

Present.—The President, Mr. G. de V. Davis, Mr. J. M. Vincent (Qld.), Dr. E. T. Edwards (N.S.W.), Professor J. R. A. McMillan (A.C.T.), Mr. H. P. Brown (S.A.), Mr. F. C. Butler (W.A.), the Hon. General Treasurer, Mr. F. C. McCleery, and the Hon. General Secretary, Dr. F. T. Bowman.

School of Horticulture.—Since all Branch reports were to hand, a sub-committee consisting of Professor McMillan, Mr. R. H. Anderson and Dr. Bowman was appointed to collate the reports on this subject with a view to their consideration at the Perth meeting.

Salaries and Status.—Council expressed appreciation of an excellent report on this subject presented by Mr. F. C. Butler on behalf of a sub-committee. The report will come before the Perth meeting.

"*Australian Journal of Agricultural Science.*"—Proposals which have been formulated by C.S.I.R. for the Journal of Research which it contemplates publishing were considered in the light of the volume of specifically agricultural research work that is being done in Australia. It was resolved that the Executive of C.S.I.R. be requested to establish a third series of the proposed journal to cover research in agricultural science.

Membership.—The following were admitted to the various Branches shown as :

Corporate Members.

A.C.T.
Mr. F. McL. Bennett.

N.S.W.
Mr. R. W. Condon.
Mr. E. G. Cuthbertson.
Miss Joy Garden.
Mr. A. F. Gurnett-Smith.
Mr. D. J. McFarlane.
Mr. C. H. McPhillamy.
Mr. R. H. Martin.
Mr. B. F. Regan.
Miss D. E. Shaw.
Dr. Joan Tully.

Queensland.
Mr. S. G. Burns.
Mr. J. H. Buzacott.
Mr. A. F. C. Henderson.

S.A.
Miss Judith Grace.
Mr. W. B. Harris.

Victoria.
Mr. J. S. Ballantyne.
Mr. C. R. Brough.
Mr. B. V. Fennessy.
Mr. N. McC. Tulloh.
Dr. Imre Molnar.
Mr. A. D. North.
Dr. J. Clunies Ross.
Mr. J. A. Roberts.
Mr. R. M. Stephens.

Student Members.

N.S.W.
Miss L. J. Bancroft.
Mr. J. H. Ballard.
Mr. J. A. Beattie.
Mr. K. G. Beirne.
Mr. B. M. Braithwaite.
Mr. P. K. Briggs.
Mr. J. S. Bunt.
Mr. J. Christian.
Mr. F. H. M. Collins.
Mr. A. Corbould.
Mr. T. J. Croft.
Mr. N. C. Crowley.
Mr. J. E. Dent.
Mr. J. J. Dillon.
Mr. L. J. Durham.
Mr. A. L. Dyce.
Mr. A. M. Evans.
Mr. P. J. Fellen.
Miss J. N. Friend.
Mr. T. McS. Gallagher.
Mr. J. B. Harrington.
Mr. J. P. Hogan.
Mr. D. M. Hunt.
Mr. E. H. Jacob.
Mr. H. V. Jenkins.
Mr. A. P. Kennedy.
Mr. G. W. Kyneur.
Mr. J. C. Lamrock.
Mr. D. A. Lewis.
Mr. L. W. Lockhart.
Mr. J. G. McGrath.
Mr. R. D. McKenzie.
Mr. J. McPhillips.
Mr. E. M. Matheson.
Mr. M. K. Maxwell.
Mr. P. F. May.
Mr. J. R. G. Morschel.
Miss S. M. Murray.
Mr. R. McD. Parrish.
Mr. K. V. Peisker.
Miss M. D. Penny.
Mr. K. H. Phillips.
Mr. G. R. Scott.
Mr. A. L. Searle.
Mr. M. E. Stannard.
Mr. B. C. Stevens.
Miss J. A. Stubbs.
Mr. P. G. Valder.
Mr. P. H. Walker.
Mr. S. A. Waring.
Mr. K. A. Watson.
Miss E. G. Wingrave.

S.A.
Mr. P. McK. Barrow.
Mr. M. B. Beck.
Mr. E. D. Carter.
Mr. G. R. Edwards.
Mr. R. J. French.
Mr. W. F. Nankivell.
Mr. D. S. Plush.
Mr. H. P. C. Trumble.

MEETINGS OF BRANCHES.

Australian Capital Territory Branch.

On 9th July, 1947, Dr. C. Barnard addressed the Branch on "Some Horticultural and Agricultural Problems of Norfolk Island". After tracing the history of the island, Dr. Barnard spoke of the peculiar problems associated with the rise and decline of the banana, citrus, passion fruit and bean seed industries.

New South Wales Branch.

A joint meeting of the N.S.W. Branch and the N.S.W. Division of the Australian Veterinary Association, held on 1st July, was addressed by Dr. P. R. McMahon, formerly Wool Metrologist in charge of wool production research for the New Zealand Department of Scientific and Industrial Research. The speaker dealt with investigations on wool production in New Zealand.

Sheep growing crossbred wool had been the basis for almost all the research carried out, but there was ample evidence to suggest that the broad principles of the results applied equally to the Merino, on which the wealth of Australia was largely dependent.

The work of the Wool Metrology Laboratory had commenced with a study of the relative importance of heredity and environment, to discover whether improvement in sheep productivity could be achieved most efficiently through breeding or through improved feeding. Although the methods used were statistical, the results could be stated fairly simply. Some features were

found to be very strongly inherited ; other features were moderately strongly inherited, but most of the features which contributed directly to the income of the sheep owner were very weakly inherited indeed and variation in these features was brought about almost entirely by environmental effects.

In the strongly inherited group were such features as coat colour, horns and the halo hairs or " mother hair " of the lamb. Inheritance frequently followed a simple Mendelian plan, but although potentially the variability was great, e.g. black versus white coat colour, in practice breeders had long ago decided on an optimum and eliminated the undesirable types from the breed.

In the moderately inherited group were such features as wool quality number or " count ", shape and covering of head, and features of the skeletal structure such as length of leg. In these features there was no clearly defined and universally accepted optimum and as a consequence a relatively large amount of genetic variability had been retained in our breeding stock.

The weakly inherited group consisted of features like fleece weight, fleece character and rate of body growth and fleshing. In these features the optimum has always been clearly defined and, over a period, breeders have removed the genetically low producing types from their breeding stock. At the same time, they have emphasized any tendency to react to a favourable environment. The net result has been to reduce the ratio of genetic to environment variability and the features then become weakly inherited. In such features the appearance of an animal is only a poor guide to its breeding ability or genetic make-up and this means that only very slow progress can be made in improvement by selection and mating " best to best ". Special methods of breeding, notably the use of the progeny test, coupled with accurate records of the productivity of each sheep under conditions minimizing environmental effects, are essential if further rapid progress is to be achieved beyond the already high standard reached by practical breeders working over a long period of time.

There was considerable evidence to suggest that breeders were in effect making very little progress in improving the productivity of our present-day sheep breeds. They were changing the strongly inherited and moderately strongly inherited features which produced big changes in the type and appearance of the sheep without affecting productivity to any marked degree.

Dr. McMahon then mentioned some results of a survey carried out on a large scale by sampling fleeces at shearing and obtaining records of fleece weight, type, count, etc. It was found that the comparative values of different counts varied with the type of country, in accord with breeders' experience that strong wool is more suitable for good country, fine wool for poor country.

The results of the survey were also analysed for the most frequent defects. In 50 per cent. of fleeces there was an appreciable degree of tenderness near the base of the staple (a result of a combination of pregnancy and inadequate feeding during the winter months). Tender fleeces were noticeably lighter than normal fleeces. It was calculated that breaks and tender wool were costing the New Zealand woolgrowing industry one million pounds per annum.

Work on feeding showed that changes in the plane of nutrition affected fleece weight rather than count.

Other research was directed toward obtaining information on some of the defects which were said to be important from the point of view of manufacture, such as content of medullated fibres.

Queensland Branch.

On 28th May Dr. J. G. Davies gave an address on some problems of summer rainfall pastures, which characterize a large proportion of the State ; a long discussion followed the address.

Dr. Davies stressed the climatic differences between the summer rainfall areas and those of the winter rainfall type in southern Australia, where pasture improvement was proceeding fairly smoothly. In Queensland there was probably four to five times as much good rainfall country as in Victoria, yet improved pastures in Victoria cover at least twice the area of those in Queensland. There are three reasons for this :

(i) The distribution, amount and reliability of the rainfall are different ;
(ii) legumes such as subterranean clover, red clover and white clover can be employed in Victoria ;
(iii) it has been possible in Victoria to apply old and proven agricultural techniques imported directly from other cool, temperate regions.

In the summer rainfall areas new plants and new techniques require to be found.

Climate is the most important determining factor of plant growth ; and a continuous supply of soil moisture is necessary for sustained high plant production. Maintenance of the soil moisture supply depends on both climatic and soil factors. In South Australia Trumble obtained rather striking correlations between the duration of the period over which moisture was available and the distribution of herbage plants such as subterranean clover. Such correlations do not hold in Queensland because the soil type plays a much greater part, e.g. the black soils of the Darling Downs and the sandstone soils on their southern margin differ greatly in productivity, although the conditions of rainfall are similar. A factor of special importance here is the capacity of the black soils to hold water. This property is emphasized by the discontinuity of the rains in the summer rainfall areas ; the more continuous type of rainfall season found in southern Australia does not apply. Frequent drying of the soil is further induced by the active growth of plants at the high temperatures associated with summer rains.

Deficiencies of the soils in plant nutrients were also dealt with by Dr. Davies. Attention has been concentrated on the better soils in Queensland ; but there are vast areas of podsolic and other degraded soils along the coast under conditions of reasonably good rainfall. It is safe to assume that such soils are likely to be deficient in some major and trace elements.

Much work is required to assess the deficiencies of these poor soils. At Rodd's Bay there are indications of phosphate deficiency. Natural grasses have not shown any response to phosphate, but *Stylosanthes sundaica* has.

A lack of protein is probably the main factor limiting production and this applies to the beef, dairying and sheep areas of the better rainfall districts. It has been recently shown that poor growth and the high death rate of weaners, thought earlier to be due to parasites, are the result of poor nutrition. To overcome the dearth of protein has become an objective of many workers in this country. A blanket legume such as subterranean clover is not yet in sight and it may not be necessary to look for such a plant. Work at South Johnstone on Centro (*Centrosema pubescens*), Puero (*Pueraria phaseoloides*), Calopo (*Calopogonium mucunoides*) and Stylo (*Stylosanthes guianensis*) is both important and encouraging. Promising results have also been obtained on the central coast with Stylo, *Cajanus* and *Arachis*. The exploitation of a new plant might well mean the adoption of new agricultural techniques.

The gross yield of dry matter is not the major factor determining the carrying capacity and from the same yield an improved distribution of the food supply may well improve animal production. A *Danthonia* pasture in the south may produce 80 per cent. of the dry matter of a Phalaris–sub-clover mixture, yet the carrying capacity of the latter is four to five times as great. The first point here is that the clover burr is available to sheep in the summer ; the second is that there is much loss from the annual grasses in unimproved pastures because as much as 75 per cent. of their protein is transferred to the seed, which may become inedible or inaccessible.

In Queensland, winter and early spring feed is hopelessly inadequate for the needs of the stock. The burning of dry winter growth to provide a green shoot is extremely wasteful of moisture, for the loss of every ton of dry matter represents a loss without a return of feed of at least five tons of moisture. Somehow plants must be secured which will retain their nutritive value into the winter period and so not dissipate moisture without a good return of feed from the rain falling in summer.

The June meeting of the Branch was addressed by the President, Mr. D. O. Atherton, on native agriculture in New Guinea. The speaker, who served as a Lieutenant-Colonel with the A.N.G.A.U. during the concluding stages of the last war, had come into close contact with native agriculture in that island. It is hoped to publish an account of his address in a later issue.

Tasmanian Branch.

At a meeting of the Tasmanian Branch in June, Mr. D. Martin (C.S.I.R.) spoke on the " Size Factor in Apple Storage Experiments ". He pointed out that on an apple tree the size of the individual fruits is distributed normally. One may therefore arrive readily at a mean size of the fruit on the tree, a value which is a function of the number of fruits relative to the number carried in previous years and the growth conditions. It can also be shown that acid content, soluble solids content, firmness and other properties of the individual fruits are distributed normally, but that either there is no correlation between size and these other variables, or such correlation is poor and irregular. This is rather surprising in view of the frequent linear relation between the incidence of disorder and the size group on a tree.

When we compare the properties of fruit from different trees in relation to the mean size of the fruit from each tree, we can get a clearer picture, for then we find that there is not only a definite linear relation between mean size of fruit and the chemical and physical properties of the fruit from it, but also an equally definite curvilinear relation between mean size and the incidence of disorders. In addition this latter relation holds good when the fruit of the same size group from trees of differing mean fruit size are compared as well as for the comparison of the crops as a whole.

In any one season, therefore, when the climatic conditions for an experiment plot may be assumed to be constant for all trees, mean fruit size per tree is an expression of the fundamental physiology of the fruit from that tree. In addition there is a further, though less marked, relation between the size of the fruit within the tree and its storage behaviour. The mean fruit size per tree is merely a convenient method of expressing the more fundamental relation of the fruit to the leaf area it can draw on for photosynthetic products.

There are very few experiments on storage disorders which would not be of much greater value if the fruit from each tree in the plot were kept separate and the mean size of the fruit from each tree determined. In the past, while valuable practical results have been obtained in comparing the effects of manurial treatments on storage quality without acknowledging the size factor, the time has come when a more fundamental approach is desirable and we must know whether the effect of a manurial treatment is to produce a fundamental chemical change or merely on fruit size.

Experiments involving comparisons of effects of picking at various stages, such as of maturity, introduce a complication, for while fruit is maturing it is also growing and in some cases variations in storage behaviour thought to be due to increasing maturity could equally well be due to an increase in size.

In comparing behaviour from one year to another it is almost impossible to dispense with the recognition of the mean fruit size or crop factor, and we are faced with the very complicated problem of allowing not only for this but also for such other influences as fruit maturity and a possible decline in tree capacity with age before any attempt to trace climatic effects can be made. By that time results begin to appear unreal.

Victorian Branch.

Miss M. E. H. Cowen, Seeds Analyst, Department of Agriculture, addressed members on " Some Aspects of Seed Production and Seed Testing in New Zealand " at a meeting on 23rd May. After describing her comprehensive tour in the Dominion, Miss Cowen said New Zealand produced great quantities of small seeds, particularly of grasses, clovers, brassicas, peas, other vegetable and flower seeds. Most was produced in the South Island where the climate was more favourable for harvesting. The main seed producing districts were Canterbury, Southland, Otago, Marlborough and Hawke's Bay.

Crops were cut with a binder, stooked and threshed ex-stook or stack, or cut with a mower, or sometimes cut with a binder and allowed to lie loose on the stubble for about three weeks before threshing with a header and pick-up attachment. Some crops were direct headed but usually had to be dried and, in some cases, were stripped. This was the case with " brown top ". Pea seed crops were usually cut with a mower and picked up and threshed. Vegetables such as cauliflower and cabbage were usually cut with a reaping hook and threshed in the paddock. Flower seeds were hand harvested.

The New Zealand seed certifications schemes were complex, said Miss Cowen. At Palmerston North new grass strains were built up and tried out in different districts. If they proved satisfactory, nuclear stocks were built up at the agronomy division at Lincoln. Nuclear stock seed was distributed to selected growers for the production of Government stock seed which was sold by the Department of Agriculture. From pastures sown with Government stock seed, pedigree seed was harvested which in turn yielded mother seed. All lines of seed in these grades were plot tested. The lowest grade was called permanent pasture seed. It depended for certification on laboratory strain tests. The picric acid test was used for white clover to measure colorimetrically the amount of cyanogenetic glucoside in the clover. The lowest grades of other seed lines had to be plot tested. The lowest grades of cowgrass, short rotation ryegrass and annual types were called standard seed.

The official seed testing station at Palmerston North was a very much bigger station than anything in Australia, Miss Cowen continued. It did as much work as all Australian stations put together. There were about 70 on the staff, which was expertly supervised. Notwithstanding the difference in size between the station at Palmerston North and that in Victoria, she came to the conclusion that the work at both places was being done along the same lines. In some respects the technique adopted in Victoria was better. Miss Cowen was interested in the attitude of the Dominion to weed seeds and germination standards. There was no Seeds Act in New Zealand and the Dominion grew practically all the seed it required. Australia on the other hand was largely an importing country and consequently had to adopt standards to prevent further introduction of serious weeds.

On 20th June, Mr. J. S. Ballantyne, Liaison Officer with the War Service Land Settlement Division of the Ministry of Post-War Reconstruction, spoke on " War Service Land Settlement—Policy, Plans and Progress ". He traced the history of the war service land settlement agreement between the Commonwealth and States, emphasizing five of the basic principles involved. These were that settlement should be undertaken only where economic prospects were good, applicants had to satisfy a competent authority as to their suitability and experience, holdings should be big enough for efficient operation, lack of capital should not preclude settlement and adequate guidance and technical advice should be available. To implement the agreement the Commonwealth set up a War Service Land Settlement Division and each State a Soldier Settlement Commission.

The Commission had acquired large areas, particularly in the Western District, and survey, subdivision, pasture improvement, housing and allocation were proceeding. About 5,000 applicants had been classified for " suitability ", with the aid of local ex-servicemen's organizations. Provision of rural training had been undertaken by the State at Dookie Agricultural College, where 60 students received a two months' course in the principles of farming. The school opened during May. A series of booklets—something new in the way of agricultural text-books—had been prepared for use during the course.

A number of potential settlers was also receiving practical training on approved farms throughout the State. Particular care had been taken, said Mr. Ballantyne, to ensure that the number of men who received training was not far above the number for whom land would be available.

The survey carried out by Professor G. A. Currie had been of special value in showing the type of training required, the extent of existing facilities and additional facilities likely to be needed in each State.

Selection of settlers was left to each State. In Victoria a system of straight-out selection was adopted, but in New South Wales and Queensland a ballot was held among men with suitable qualifications.

Valuations of holdings were carried out according to provisions in the agreement but were based on the needs for the proceeds of the holdings being sufficient to provide a reasonable living for a settler after meeting all commitments assuming he had no capital. This type of valuation had never been used before in the Commonwealth. It involved price estimates for commodities over, say, the next twenty years, and this was being done by the Commonwealth Bureau of Agricultural Economics. Many other factors had to be considered, including trade agreements, price level trends, farm size, changes in population, etc.

Another problem was the degree of development necessary on a block before it was allocated to a settler. Materials supply was a severe handicap to progress and there was a different conception to-day as to what constituted adequate housing compared with the situation just after the 1914-18 war.

The principle of settlement relating to guidance and technical advice to settlers was a direct challenge to State Departments of Agriculture. The short course at Dookie provided a magnificent opportunity for contact between future settlers and those officers best able to advise them later when they were farmers in their own right, Mr. Ballantyne concluded.

Western Australian Branch.

At the annual general meeting on 2nd May, 1947, the following office-bearers were elected : President, Mr. H. R. Powell ; Vice-President, Mr. A. J. Millington ; Committee, Messrs. R. C. Rossiter, L. T. Jones, R. J. Moir and I. Bonnerup ; Hon. Treasurer, Mr. F. O. Grogan ; Journal Sub. Editor and Publicity Officer, Mr. H. L. Harvey ; Hon. Secretary, Mr. H. G. Cariss ; Student Representative, Mr. W. McNeil ; Hon. Auditors, Dr. L. W. Samuel and Mr. A. M. Stewart.

The annual report showed membership at 31st December, 1946, as 73 corporate and 19 student.

Mr. G. R. W. Meadly delivered his presidential address on " Some Aspects of Seed Germination, with Particular Reference to Subterranean Clover ". We hope to publish an account of this address in a subsequent number of the Journal.

On the 13th June, 1947, Sir William Jenkins, formerly of the Indian Agricultural Service, addressed a general meeting on " Some Aspects of Agriculture in Western India ".

The great problem of India was that of improving the standard of native cultivation, and the future welfare of the country must ultimately depend on the uplift, education and organization of the village cultivator.

The average area under crop cultivation each year was about 300,000,000 acres. Of that area slightly over half was devoted to the production of the major food crops, which in order of importance were rice, the millets, wheat and other cereals. That acreage, large as it seemed, was the larder for a population of 400,000,000 persons, increasing, it has been said, at the rate of 5,000,000 annually.

In order to attain the barest degree of national self-sufficiency and to provide the minimum requirements of a balanced diet, the production of foodstuffs would have to be increased by the following percentages : cereals, 10 ; pulses, 20 ; fats and oils, 250 ; fruits, 50 ; vegetables, 100 ; milk, 300. Here lay the real problem that governments of the future would have to face.

The low production results in the main from the low standard of cultivation and fertility of the soils, combined with extensive soil erosion and often inadequate, untimely and maldistributed monsoonal rains.

Steps are being taken to improve the breeds of Indian cattle which are the main source of power in cultivation, but progress is necessarily slow. The introduction of a scheme for the issue of " premium bulls " will assist in the provision of better stock for cultivation purposes, but the lack of adequate grazing and concentrates is a serious hindrance to the scheme.

Indian soils appear to have become stabilized at a comparatively low level and there are naturally great possibilities for increased production from suitable manuring practices, both organic and inorganic. Farmyard manure is the common source of the former, but the manufacture of compost is being widely adopted. Inorganic fertilizers necessarily have a restricted application due to lack of finance. One of the most urgent and most neglected problems is that of soil erosion, which is seriously reducing production over half the cultivated area of the country. Soil conservation has received particular attention over the past few years, and investigations have shown that a combination of field banking (" bunding ") and scientific dry farming can increase the yield of crops by at least 25 per cent. in a normal rainfall year. Food production is further restricted by inadequate irrigation and although several large schemes are in operation, only the fringe has been touched.

Crop wastage due to insect pests and plant diseases is also a serious problem in India, but considerable progress has been made by the production of resistant plants and the distribution of higher yielding crop varieties.

Milk production is exceptionally large, approximately 6,000,000,000 gallons being produced per annum, but the *per capita* consumption of milk is estimated not to exceed seven to eight ounces. Although there are many good breeds of milk cattle, yields are extremely low, e.g. 600 lb. per annum or from 4 to 6 lb. daily. Proper animal husbandry methods demonstrated on government farms and military dairies have produced yields up to 6,000 lb. and over. Wool production, too, requires and is receiving considerable attention, as few breeds of sheep yield more than 2 lb. annually of very poor quality wool.

Though the normal source of power comes from the use of cattle, mechanical cultivation can be used both effectively and economically in certain special operations, such as original clearing of land and the jungle, soil conservation work, and the eradication of deep-rooted weeds, but the prospects of any large-scale production equipment for the farming industry do not appear to be very great.

In conclusion, the speaker dealt briefly with the future possibility of trade between Australia and India in connection with agriculture and allied industries, pointing out that for many years to come India would need imported food grains and other pressing requirements, and the secondary industries of Australia would also find a ready sale for their products as a result of India's agriculture.

Current Notes and News

Course of "Refresher" Lectures in Victoria.

With the co-operation of the Melbourne University School of Agriculture the Victorian Branch will conduct a series of fourteen "refresher" lectures during October. The school will last from October 27th to 31st, and will be open to all Institute members. Lectures will be given during the day only, probably in three sessions, and the following subjects will be covered: soils, three lectures; plant physiology and plant genetics, two each; ecology, climatology, soils of Victoria, biochemistry, animal problems, soil bacteriology and extension work, one each. Members of all Branches will be welcome to attend should they be in Melbourne at that time. There will be a charge of £1/1/- for the series or 5/- a lecture. Those wishing to take part should get in touch with the Victorian Branch Secretary, Mr. L. L. Stubbs, Plant Research Laboratory, Swan Street, Burnley, E.1, Victoria.

Co-ordination of Agricultural Research in N.S.W.

In our last issue, reference was made to the setting up of an Advisory Committee on the Co-ordination of Agricultural Research in New South Wales, and we can now refer to some of its achievements.

The Committee first met in February, 1947, and up till the end of July four meetings had been held.

Favourable recommendations have been made for the

(1). Establishment of a Potato Breeding Station near Glen Innes.

(2) Establishment of a Citrus Research Station at Gosford.

(3) Enlargement of Condobolin Experiment Farm by purchase of two adjoining properties.

Other matters which have been considered are:

Establishment of a Citrus Research Station at Coomealla, where it is hoped to arrange a co-operative project between N.S.W. and Victorian Departments of Agriculture and the C.S.I.R.

Establishment of a Tropical Fruit Research Station at Murwillumbah as a co-operative project between N.S.W. and Queensland Departments of Agriculture.

Establishment of a Cereal Breeding Station at Tamworth.

The Department of Agriculture and the University authorities have been asked to confer on this matter to see whether or not the University station at Curlewis could also serve the requirements of the Department.

Wheat Research Institute at Wagga.

The Committee felt there was need for a clear definition of function between the Sydney and Wagga laboratories and, whilst supporting the general proposal to establish a Wheat Institute, recommended that a technical committee should first be appointed to define the functions to be discharged at each centre, and to outline in detail the problems requiring investigation.

Soil surveys.

As this matter affected a number of different bodies, including the Departments of Agriculture, Conservation and Forestry, as well as the University and C.S. and I.R., the Committee arranged for the appointment of an expert committee from these bodies to report on facilities and staff and the part that each might play in such work, both now and in the future.

Prickly pear destruction work.

Subsidies payable to shire councils for destruction of noxious weeds.

Co-ordination of agricultural research work on the M.I.A.

"Agricultural History."

The Editor of *Agricultural History*, the quarterly Journal of the Agricultural History Society, Washington, D.C., U.S.A., is anxious to extend the coverage of his Journal by including articles on the agricultural development of Australia.

The articles need not be strictly historical in character. They may be quasi-geographical or partly economic analyses. As a step in the direction indicated, the Editor of *Agricultural History* says that he would be glad to consider publishing key articles or chapters already in

print or redactions of them in order to widen the distribution of the data they contain. Any members interested in this matter should get into touch with the Librarian, Commonwealth Parliamentary Library, Canberra, A.C.T., through whom we received this advice.

Rural Training Centre at Harvey (W.A.).

This rural training centre, established under the provisions of the Commonwealth Reconstruction Training Scheme, commenced operations on 24th June with a full complement of 49 trainees in residence. Mr. K. T. Lutz is Principal and Mr. B. Williams the Chief Instructor. Both are ex-servicemen and have been seconded from the Department of Agriculture. They are assisted in instructional work by visiting specialist officers from the Department. The type of instruction given to trainees is that outlined by Dr. G. A. Currie in his " Report on Rural Training for Returned Service Personnel " published in this Journal (Vol. 12, p. 5). The course is of eight weeks' duration and the trainees have expressed satisfaction with the course given and with the provision for their accommodation and amenities.

Six to seven hundred trainees are expected to pass through the Centre. About two-thirds of these are successful applicants under the provisions of the Commonwealth War Service Land Settlement scheme, while the remainder have been accepted under the Reconstruction Training scheme. Most of the men in the latter group are " established " farmers requiring a " refresher " course. Practically all trainees expect to be either wheat and sheep or dairy farmers.

" Pastures and Pasture Research."

The University of Sydney has published a second edition of " Pastures and Pasture Research ", by C. M. Donald. Copies are obtainable from the author or from the School of Agriculture, University of Sydney.

Book Review

THE CEREAL RUSTS AS EXEMPLIFIED BY THE LEAF RUST OF WHEAT,

by K. Starr Chester.

(*Waltham, Mass., U.S.A. Chronica Botanica Co. N. H. Seward, Melbourne. Price* $5.00.)

Dr. Chester has undertaken a major task in attempting to bring together the existing information on wheat leaf rust. The cover bears the title " The Cereal Rusts ", but the author has concentrated on *Puccinia triticina*.

This publication is unquestionably the most thorough summary of the existing knowledge of any one of the cereal rusts and the author is to be congratulated on the extensive search of the literature that has obviously been made. One gets the impression that he has definitely set out to impress upon his readers the importance of wheat leaf rust. He realises that this disease has taken second place to stem rust owing to the spectacular effects of the latter but he repeatedly stresses the damage that can be done by the leaf rust organism. A real service has been done in drawing attention to this damage which so regularly occurs in wheat crops, but which, in the past has mostly gone unnoticed.

In dealing with crop losses resulting from leaf rust, four experimental approaches are considered: (i) greenhouse experiments with rusted and non-rusted wheat; (ii) field experiments in which certain plots are protected by dusting with sulphur; (iii) field experiments in which leaves are removed to simulate rust attack; and (iv) field trials on lines which are genetically similar except for their reaction to leaf rust. A graph is presented from an analysis of results of the first three approaches and it shows the percentage of crop loss at varying stages of development.

The usual aspects of any rust pathogen are dealt with in various chapters, symptomatology, etiology, physiologic specialisation, dissemination and control. In the section on physiologic specialisation mention is made of suggestions to improve the study of races of the leaf rust pathogen. Standard temperature conditions are of course mentioned and the desirability of having a central library of rust cultures is recommended. The author further suggests that growing of the plants in sand supplied with nutrients would be an additional help. He is probably over enthusiastic about the usefulness of this refined technique and from a plant breeder's point of view one feels there is greater justification for his proposal to reduce the number of leaf rust differential varieties. The present number is excessive and in any case, each country has to supplement an international list by certain local varieties in order to get a true picture of the rust flora. The book concludes with a section on breeding for resistance to leaf rust.

There are a few printing errors, but throughout the book the author has maintained a high standard in clarity of presentation. Production is typical of the Chronica Botanica series and any who are engaged in a study of cereal rusts would find Dr. Chester's book a worthwhile addition to their book shelves.

I. A. Watson.

Obituary

A. W. S. MOODIE.

Mr. A. W. S. Moodie, Chief of the Division of Plant Industry of the New South Wales Department of Agriculture, died suddenly on the 26th April, 1947.

Andrew W. S. Moodie received his training in agriculture at the Hawkesbury Agricultural College, Richmond, where he obtained the Diploma in Agriculture and later the Diploma in Dairying. As a student he was always in the top rank both in his agricultural work and on the sports field ; Mr. Moodie excelled in cricket and tennis.

Mr. Moodie's first appointment to the Department of Agriculture was in October, 1920, as Assistant Experimentalist at Grafton Experiment Farm, and three years later he was selected as the most suitable of the then experimentalists for transfer to Head Office as Assistant Agrostologist. As the staff of this Branch increased in size, Mr. Moodie assisted in the training of agrostologists and in the supervision of their country activities.

From 1930 until the outbreak of World War II a considerable amount of pasture research work was developed at all experiment farms, and Mr. Moodie materially assisted in designing and supervising many of these trials. During this period, Pasture Improvement Competitions were at their peak, those with a State-wide application being the Royal Agricultural Society's Grassland Championships and the " Farmer and Settler " Dairy Farm Improvement Competitions, and Mr. Moodie assisted in the judging of these important educational movements.

He was appointed Chief Instructor in February, 1944, and Chief of the Division of Plant Industry in April, 1946.

Mr. Moodie immortalized himself in the agricultural annals of New South Wales by the Agricultural Holdings Act, which was placed on the Statute Book largely through his initiative and his long and deep study of the subject. It was an attempt not only to remove one of the fundamental bars to agricultural progress but to have justice meted out to all men, especially to the hard-working " under-dog ".

In his short career in the positions of Chief Instructor and Chief, Division of Plant Industry, Mr. Moodie earned the respect of all for his fair, logical and wise judgment and administration. He endeared himself personally to all by reason of his approachable, sympathetic and friendly disposition, and was one of the rare number who never made a single enemy.

H. WENHOLZ.

Personal Notes

Mr. K. D. McLauchlan has transferred from the Bureau of Agricultural Economics to the Agrostology Section, Division of Plant Industry, C.S.I.R.

Dr. C. Barnard recently visited Norfolk Island at the invitation of the Department of External Affairs, to investigate horticultural problems of the Island.

Mr. A. F. Bell, formerly Assistant Under Secretary (Technical) in the Queensland Department of Agriculture and Stock, has been appointed to the position of Under Secretary. At the same time, Mr. R. Veitch has been appointed Technical Assistant Under Secretary and Dr. W. A. T. Summerville, Chief of the Division of Plant Industry in the same Department.

Mr. D. O. Atherton, Assistant Director of Agriculture in Queensland, was a member of a recent survey party sent out by the Queensland Government to investigate possible sites for experiment stations in the Gulf country.

Mr. N. E. H. Caldwell, formerly entomologist with the Queensland Department of Agriculture and Stock and stationed at Townsville, has been transferred to the Division of Horticulture in the same department.

Dr. D. A. Herbert, a past president of the Queensland Branch of the Institute, has been appointed associate professor in the Biology Department of the University of Queensland.

Mr. C. J. McKeon, Queensland Director of Agriculture, has recently returned from America, where as a member of a party sponsored by the Commonwealth Government he investigated the soybean industry.

Mr. L. E. Nichols, who has recently brought to a successful conclusion his research work on the production of a non-sweating, full-flavoured cheese, has been appointed Acting Assistant Director of Dairying and Senior Dairy Technologist in the Queensland Department of Agriculture and Stock.

Mr. R. J. Wilson, previously Senior Agricultural Organiser for the Northern Division in the Tasmanian Department of Agriculture, has been appointed to the position of Investigation Officer, Bureau of Economics, Department of Commerce and Agriculture, Canberra.

Mr. G. C. Wade has been appointed to the position of Plant Pathologist in the Tasmanian Department of Agriculture.

Mr. R. A. Sherwin, who was Chief Agronomist in the Department of Agriculture before going into business in New South Wales, recently returned to Tasmania and has been appointed secretary to the Field Peas Board.

Dr. T. C. Dunne has been appointed Plant Nutrition and Research Officer in the W.A. Department of Agriculture. He was formerly Horticultural Research Officer.

Mr. T. J. Robinson, of the W.A. Department of Agriculture, has graduated M.Sc. in Agriculture in the University of Western Australia. His thesis dealt with œstrogenic activity in early subterranean clover.

Mr. A. J. Millington, Geneticist, W.A. Department of Agriculture, has resigned to take up duties as Senior Lecturer in Agriculture and Plant Breeder at Roseworthy Agricultural College.

Mr. F. O. Grogan has been appointed Senior Research Officer in the Bureau of Agricultural Economics of the Commonwealth Department of Commerce and Agriculture. He is now acting as Investigation Officer for the Land Use section of the Bureau in Western Australia for advisory work in connexion with the War Service Land Settlement Scheme.

Mr. D. Duncan has returned from the United States and has commenced duties as Senior Lecturer in Agricultural Biometry at Sydney University. He has been awarded the Ph.D. degree of Iowa University.

Mr. Max Henry, Chief of the Division of Animal Industry and Chief Veterinary Surgeon of the N.S.W. Department of Agriculture, retired at the end of June. He is succeeded by Mr. W. L. Hindmarsh, Director of Veterinary Research at the Glenfield Veterinary Research Station.

Dr. N. S. Noble has resigned from the position of Secretary to the Linnean Society of N.S.W. to become Editor of the new series of scientific journals to be published by the Council of Scientific and Industrial Research and the Australian National Research Council.

Mr. W. H. Poggendorf has been appointed Chief of the Division of Plant Industry, N.S.W. Department of Agriculture, in succession to the late Mr. Moodie.

Mr. A. V. Robinson has been appointed Chief Chemist, N.S.W. Department of Agriculture, in succession to Mr. E. L. Griffiths, who has retired.

Mr. S. M. Sykes, Assistant Fruit Research Officer, N.S.W. Department of Agriculture, left Sydney in April for the United States and Canada, where he will investigate the latest developments in quick freezing of perishable foodstuffs.